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VOL. LXXXVIII. AUGUST 26, 1905. No. 1548.

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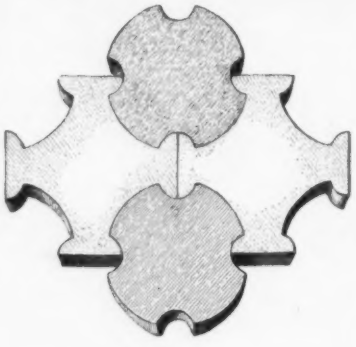

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PERSONAL MENTION.

BOSTON, MASS.—Mr. Ralph Adams Cram, architect, has two volumes coming out this fall through different publishing houses. James Pott & Co. will issue a book by him on *The Ruined Abbeys of Great Britain*, and the Baker & Taylor Company will publish his *Impressions of Japanese Architecture and the Allied Arts.*

COLUMBUS, O.—Mr. Wilbur T. Mills, architect, has arranged to lease a suite of offices in the McCune building at the corner of High and Gay streets, and expects to move into the new offices about Sept. 15.

CLARKESBURG, W. VA.—Mr. Robert C. Lafferty, the junior member of the firm of Holmboe & Lafferty, architects, and his wife, have sailed direct from New York to Naples, where they will remain a few days before going to Rome, where they each intend to take courses in the academy.

LITTLE ROCK, ARK.—A new firm of architects has just been organized in the city by Frank W. Gibb and Theodore M. Sanders, under the name of Gibb & Sanders. Mr. Gibb has been in business here for many years, and Mr. Sanders, formerly in his employ as draftsman, is a graduate of the Little Rock High School, has had several years active experience in architecture, and has just returned from spending a year abroad.

JERSEY CITY, N. J.—Mr. C. Fred Long, architect, has announced through Counselor James D. Northrop he would start suit in the New Jersey Supreme Court against the Board of Hospital Trustees for $24,000 damages, $14,000 of this is the price he was to be paid for his plans and the other $10,000 is for damages to his reputation.

NEW ORLEANS, LA.—Mackenzie & Goldstein is the name of the new architectural firm which very recently started business in this city, with offices in the Tulane-Newcomb building. The members of the firm are H. Jordan Mackenzie and Moise N. Goldstein. Mr. Mackenzie first came to this city about five years ago. He came with a record, covering a period of twenty years in architecture, and in the time he has been here his work has attracted attention.

Moise E. Goldstein is a graduate of the Massachusetts Institute of Technology as a Master of Science, and has had valuable experience in architectural practice in Boston and the east.

WASHINGTON, D. C.—The Secretary of War, Mr. Taft, has recently appointed Mr. Taylor's principal assistant, Mr. Wheaton, Architect of the War Department, at the suggestion of Quartermaster General Humphrey, with a view to improving the architecture of the buildings at military posts, which has heretofore been subservient to the instructions of military officials.

NOTES AND CLIPPINGS.

A CONFEDERATE MONUMENT.—A movement is on foot at Jackson, Miss., to secure an appropriation from the Mississippi Legislature for a monument to the Confederate

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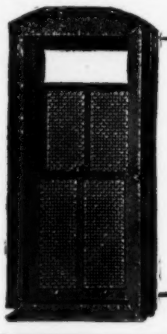

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troops in the military park at Vicksburg. It is said that $100,000 is to be asked for this purpose.—*Exchange.*

Belgian Canals.—In Belgium the splendid system of waterways and canals play an active part in the commercial and industrial enterprise of the country. The total area of the country is only 11,373 square miles, yet there is the high proportion of one mile of waterway to every 8.3 square miles of territory.

Earthquakes. — *A Study of Recent Earthquakes*, by Dr. C. Davison (Walter Scott Co., 6s.), who somewhat ambiguously styles himself on the title page as "author" of the Hereford Earthquake of Dec. 17, 1896, covers a good deal of ground that has as yet been occupied by no treatise with which we are acquainted. It gives detailed studies of individual earthquakes, rather than a discussion of the general phenomena. Those dealt with are the earthquakes at: Naples, 1857; Ischia, 1883; in Andalusia, 1884; Charleston, 1886; in the Riviera, 1887; Japan, 1891; Hereford, 1896, and Inverness, 1901; and the Indian catastrophe of 1897. Here again it becomes clear to the reader that the crumpling and fracturing of the crust of the earth arise from the slow annealing process to which it has been subjected from the earliest times. Over the whole of the surface of the globe are faults the growth of which has required an infinite period of time. There is hardly any portion of these countless faults which is not steadily, but not necessarily uniformly, growing. Perhaps Great Britain is one of the very few countries which has attained a condition of comparative stagnation, and yet there have been at least two small shocks within the last twelve months; but earthquakes in the British Isles are few in number and of little moment. Compare this immunity with the 306 earthquakes in the island of Zante in 1896, or the 1,746 shocks recorded at Gifu during thirty days in 1891! These constitute as it were a vision (through what we may call a "time-microscope") of the infinite number of steps required in the growth of a fault. And if so of a fault, what of the number of steps in the growth of a mountain chain?—*Indian Engineering.*

"The Union Forever".—I talked with one of the teachers in the stock-yards district just before Memorial Day. She had had her boys singing war songs in preparation for a patriotic celebration. There was one she had to cut out—it was "Rally 'Round the Flag." The trouble was in the chorus:

"The Union forever! Hurrah, boys, hurrah!
Down with the traitor and up with the star!"

To her crowd of descendants of the builders of Babel, speaking all the tongues which followed the collapse of that attempt to unionize all the building trades, there was but one meaning to be attached to the expression "The Union Forever." It was the labor union. And "Down with the traitor!" meant "slug the scab." So a more pacific song was substituted.

It is not certain that every teacher would have cared to make the substitute.—*Boston Transcript.*

A City Shade-Tree Ordinance.—The city of Pomona, Cal., has enacted an ordinance to control the shading of its thoroughfares, which, though it does not secure uniformity at the start, will bring it about in time, and none of the existing shade trees will be destroyed until provision is made for others to take their places. The principal features of the ordinance are as follows:

Section 1. No shade trees shall hereafter be set out by any property holders in the city of Pomona, except in accordance with the regulations hereinafter expressed

Seats of the Colonists

PART I

This work is intended to supplement "The Georgian Period" and to treat of the furnishings which were used in the buildings described and illustrated in the latter.

The part now published treats mainly of Chippendale furniture. It contains an illustrated Glossary of Terms by W. S. Bigelow and an Introductory Chapter by Horace C. Dunham.

It has 28 plates, each 10x14 inches, showing photographic views and "MEASURED DRAWINGS" of the best existing examples. These last, by Mr. Dunham, constitute the main feature of the work.

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by this ordinance, and then, only upon the written consent of the street superintendent.

Sec. 2. It shall be lawful for the property holders upon any given street or a majority of them, to select by petition any approved variety of shade tree, which, if satisfactory to the Board of Trustees of the city of Pomona, shall be designated by a resolution of said Board of Trustees, and shall thereafter be the only kind of shade tree to be planted on such street.

Sec. 3. If the property holders along any given street shall fail for the six months next after the adoption of this ordinance to make the selection provided for by "Section 2" hereof, then it shall be the duty of the Board of Trustees of the city of Pomona to select, by resolution, a variety of shade tree for said street, which shall thereafter be the only variety which shall be planted on such street.

Sec. 4. No shade tree shall hereafter be planted nearer than eight feet to the outside line of any alley, nor nearer than four feet to the line which would be made by continuing the property line of any street.

Sec. 5. It shall be the duty of the Board of Trustees of the city of Pomona at the time of adopting the resolution provided for in "Section 2" or "Section 3" of this ordinance, to define the limits of the street to which this ordinance shall apply, and also to specify the distances at which said shade trees shall be set from each other, which shall not be construed to require the removal of any trees heretofore planted and growing.

Sec. 6. The term of two years from and after the date of this ordinance shall be allowed to the property holders on the streets of the city of Pomona in which to set out shade trees in accordance with the provisions of this ordinance, and thereafter, it shall be the duty of the Board of Trustees to cause such trees to be planted and the cost thereof to be assessed upon the property in front of which trees are so planted.

Sec. 7. Any person or corporation violating any of the provisions of this ordinance is guilty of a misdemeanor, and upon conviction thereof shall be fined in the sum of not less than five dollars ($5.00), nor more than twenty-five dollars ($25), or shall be imprisoned in the city jail of the city of Pomona for not more than thirty days (30); or by both such fine and imprisonment; and every judgment of fine for violation of any provision of this ordinance shall direct that in default of the payment of such fine, or any part thereof, the person shall be imprisoned in the city jail of the city of Pomona until the fine is satisfied, in the proportion of one day's imprisonment for every two dollars ($2.00) of such fine remaining unpaid.

THE TIBETAN MONASTERY.—The monastic system of Tibet is a clear instance of convergence in religious institutions with independent origins. It can be clearly traced back to India, and there is no question of European influence; yet the result is very like the mediæval monasticism of Europe. The life led by Gotama himself, and set up as an ideal for early Buddhists, was the life of a wandering monk who, during the rainy season, retired into a temporary monastery. Climate rendered this wandering existence impossible in many Buddhist countries; but even in India continuous residence in monasteries early became the rule and was the recognized form of the religious life. Many causes besides superstition have contributed to foster monasticism in Tibet. One, no doubt, is the relative comfort of the life. Though the monks are theoretically ascetics, and though certain rules, such as the prohibition of intoxicants, are rigidly enforced, yet they are, on the whole, better lodged and fed than the ordinary peasantry.

It is not surprising that the monasteries have become the principal buildings in the country. Tradition directed that they should be built in remote and beautiful places; but the paucity of the population, the difficulty of obtaining food, and the severity of the weather, all favored the erection of massive and extensive buildings, having everything required for the support of life and even for defense. A large monastery is practically a university and a cathedral, as well as a residence for monks. Novices are admitted as boys and have to study twelve years before their ordination, the minimum age for which is twenty. During this period they have to pass several examinations and take part in public disputations. The larger monesteries are divided into colleges. In Debung, near Lhasa, for instance, there are four colleges, each under an abbot; and the monks have separate messing clubs and quarters according to the provinces from which they come.—*The Quarterly Review.*

Continued from page ix.

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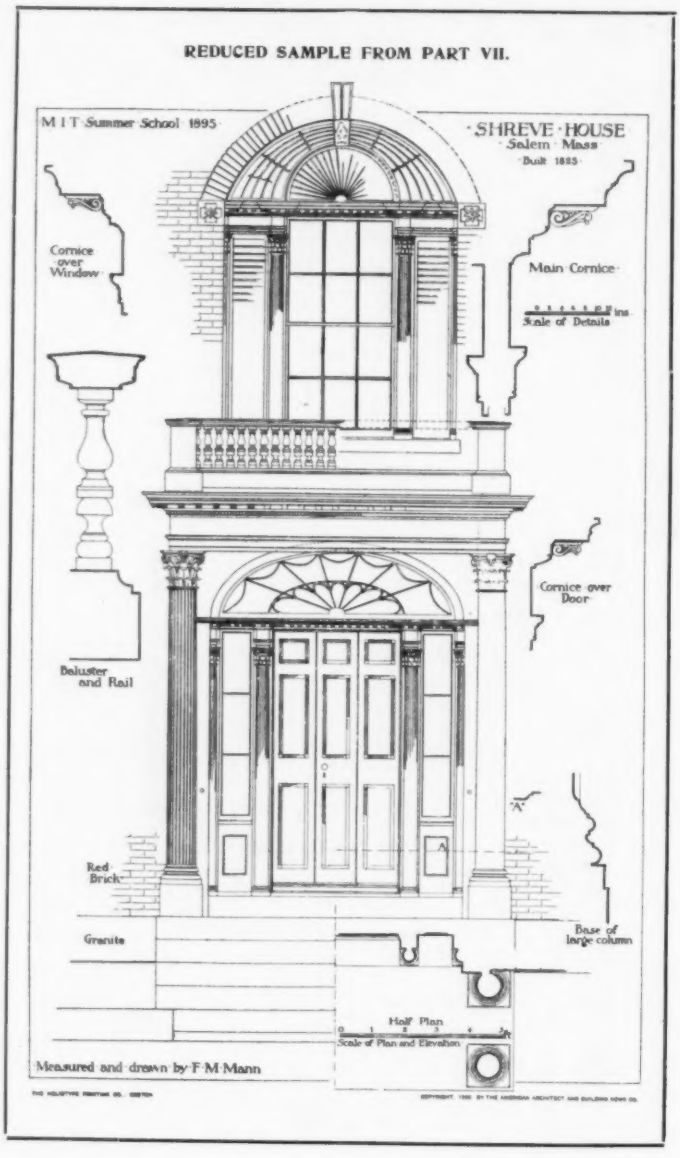

THE most important feature of this work, and the one that separates it from all other publications relating to the subject of so-called colonial architecture, is indicated very inadequately by the adjoining illustration. This is a reduced fac-simile page, one-fourth the area of the original, showing one sheet of the measured drawings, which constitute the real framework of the book. ¶ There are in all one hundred and eighty-one sheets of this sort; many of these containing much more information, as the simpler ones are necessarily chosen for reduction. ¶ Besides these drawings, there are sixty-three gelatine prints and 108 half-tone plates, and over five hundred text illustrations.

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NOTES AND CLIPPINGS.

Continued from page vi.

SEWER VENTILATION.—The question of utilizing trolley poles as sewer ventilators is under the consideration of the Wakefield (England) Town Council, and the city surveyor has been instructed to submit a plan. —*Exchange.*

APPEAL FOR AMERICAN LUMBER.—A dispatch from Berlin states that importers of American lumber, who for thirteen years have paid higher duties than those laid on corresponding imports from other countries, have asked the United States Government to intervene in their behalf, and the American Association of Commerce and Trade is sending an explanation of the grounds of protest, with documents supporting it, to Secretary of State Root. One paragraph of the explanation reads:

"The discrimination referred to dates back to 1893, when the associated German state railroads began charging 50 per cent. more on American oak, ash and pine than on the same classes of woods imported from European countries, the only excuse for such procedure being the claim that botanically there were slight differences between the American and the European species of woods mentioned. This clearly was a mere subterfuge."

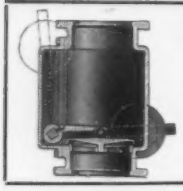
CANAL DEVELOPMENT IN EUROPE.—The London *Standard* recently contained an article in which the utility of canals was discussed, and in the course of which the progress made in the construction of these waterways in Europe was described. In contemplating the possibilities of railroads the use of canals and need for their further development seemed to have passed away, and general acquiescence was given the demand for their purchase by the railroads. But it was discovered that, with the progress of the times, the capacity of the railways in solving the question of good traffic was limited, and attention was again turned to canals, and this agency for transportation was taken up with renewed vigor and energy. Recounting what has been done in canal construction by European countries the *Standard* says:

"The digging of the great canal across the Isthmus of Suez, a colossal feat of engineering in those days, aroused the world, and set men's minds thinking that perhaps after all the day of canals had not passed away. The new era of affairs on the Continent, brought about by the Franco-Prussian war, proved in a curious way to be an important factor in promoting the use and development of the canal system. On the one hand, France, seemingly crushed by devastating war and the burden of a huge indemnity, set to work to improve the industrial condition of the people. To this end a commission was appointed to inquire into the railways and other means of communication. It followed naturally that it found the canal system of the country neglected and falling into disuse, and at once money was voted for its improvement.

"On the other had, the statesmen of Germany, recognizing that the true greatness and supremacy of a nation come not alone from war and conquest, turned their energies to facilitating the commercial growth of their Empire. Before 1870 canals languished, but by 1875 public opinion was sufficiently educated to understand the necessity for a development of the inland waterways. This feeling was stimulated by the dissatisfaction with the high rates of the State railways, and traders began to avail themselves of the low freights on the then existing waterways. During the ten years, 1890-1899, a sum of £14,950,320 was expended on inland waterways, mainly on the canalization of rivers.

"Within the last few weeks a most extensive programme has been sanctioned by the Prussian Government, involving an expenditure of £16,728,750. The greater portion of this money is allocated to the building of a canal from the Rhine to the Weser, including the canalization of the Lippe. The waterway from Stettin to Berlin is to be rendered navigable for large vessels, at a cost of two millions, and smaller sums are to be spent on improving the waterway between the Oder and the Vistula, and on the canalization of part of the Oder. This does not mark the end of the canal development. At some future date the canalization of the Moselle-Saar, the connection of Leipzig with Brisa, on the Elbe, and a canal from Schwerin to the Baltic are to be taken in hand. For some years past the Würtemberg government has been studying a scheme to construct a canal from the Rhine, starting at Mainz, utilizing the Neckar and joining the Danube at Lauingen. By this, goods from the near and far east will be carried at cheap freight from the Black Sea to the North Sea.

"The effect of this careful development of canals and natural waterways is apparent in the reduction of the cost of transport by about one-half. The present cost of carriage is now less than 0.25d. per ton per mile. The large number of river and canal boats—22,564 in 1897, as compared with 17,653 in 1877—and the increased utilization of the loading capacity have materially contributed to this reduction. The revenue, which, however, is far from representing even a fair rate of interest on the outlay, is collected from tolls based on the weight and nature of the goods carried. Goods are shipped under a fixed tariff, the rate of which every merchant knows beforehand. The general practice is to leave the navigation of the open river free, while regular charges are made on canals."



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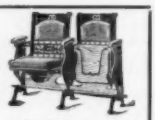

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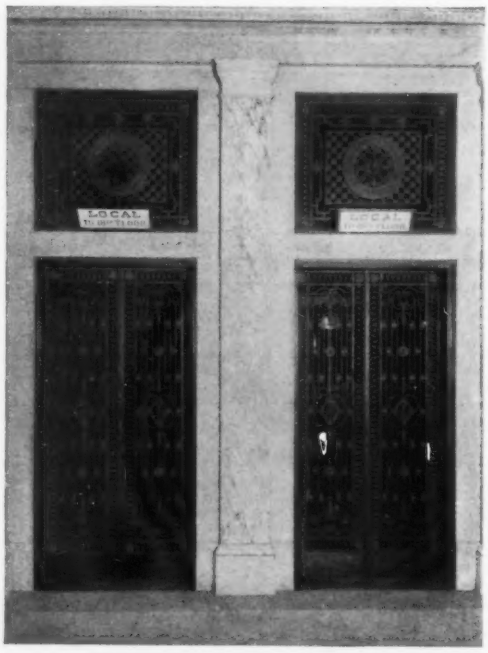

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THE fact that Mayor McClellan and the other members of the New York Board of Estimate and Apportionment have given their warm adhesion to the proposal to build a bridge over the Harlem River at Spuyten Duyvil should cause New York subscribers, at least, to regard with more than ordinary interest the illustrations of a few French bridges, published in this issue. As, to a very large degree, the feature that most largely stamps character upon a city, its buildings, is to a great extent not subject to public control, it happens that there are only one major and two minor features affecting a city's aspect that can be controlled absolutely by the civic powers, and these three elements are the street-plan, the parkings of those streets, the parkways and the parks and, finally, the bridges. It is a matter of the weightiest good fortune, in view of the way in which the natural beauties of the lower part of Manhattan Island have been wasted, that the upper part of the island remains largely in unimproved condition and so, probably, will be treated for the benefit and pleasuring of the many in the wise and judicious way that has made the Riverside Park one of the most successful pieces of landscape-architecture that the world affords. The stretches of the North and East Rivers are so great that any bridges built thereover must very largely be merely engineering structures. But the Harlem River is quite another story, and the conditions are such as to invite careful architectural treatment for the many bridges, which, sooner or later, must be thrown over a stream that New Yorkers are prone to laugh at and speak of merely as a sewer, simply because they do not really know it and have not given a thoughtful examination to its picturesque possibilities. The fact that a proper beginning has been made with two noble viaducts, High Bridge and Washington Bridge, lead us to hope that the Art Commission will have the whole weight of the community behind it, reinforcing its decision that no inartistic piece of mere ironmongery shall be erected, when the time comes to accept the design for each successive bridge.

IT is with surprise and much regret that we learn that Mr. Edward Robinson, Director of the Boston Museum of Fine Arts and Curator of its Classical Antiquities, has resigned both positions with what looks like finality. Mr. Robinson is a man of such real force and his services during the last score of years have been of such indisputable value to the institution that we, like many others, took particular satisfaction in the knowledge that he was at the head of the Museum's official staff just at the time it was preparing for a new and better growth, made possible by the impending building of a larger and better arranged museum building. Mr. Robinson, in his letter of resignation announces that he is no longer in sympathy with the trustees on important points, and is forced, out of self-respect, to take a step that so many will regret. We have no special knowledge of the causes that have led to this result, but, recalling that in the last few years the Department of Classical Antiquities has had a greater development than any other and so has benefited by a somewhat disproportionate expenditure of the Museum's income, and that the last Annual Report of the President announced that, for the present, the Museum had reached the limit of desirable expansion in this particular direction, it seems fair to surmise that here may be found one of the points of difference between the late Director and the Trustees.

ALFRED WATERHOUSE, the architect who, more than any of his contemporaries succeeded in making "Victorian Gothic" something more and better than a mere bald, lifeless and ill-understood application of Gothic forms and mouldings to modern structures, has just passed away in the seventy-sixth year of his age. It was with something like consternation that, about thirty years ago London architects learned that a mere Manchester practitioner had succeeded in producing a building of more than usual promise, the Town-hall for Manchester; but when, shortly after, the Assize-courts in the same city followed, in the same well-marked and distinct phase of the style, they were ready to agree that their author ought to come up to London and take his place as one of the leaders of the profession. The Natural History Museum at South Kensington and Eaton Hall, the Duke of Westminster's seat at Chester, followed shortly after and these were in turn followed by an ever-lengthening line of public and commercial buildings in every quarter of the Kingdom, all, as a rule, designed in practically the same style, all unmistakably stamped with the personal *cachet* of their designer. In 1878 Mr. Waterhouse was elected an Associate of the Royal Academy, became a full Academician in 1885 and, besides being for three terms President of the Royal Institute of British Architects and its Royal Gold Medallist in 1878, was a Corresponding Member of the Institut de France and an Associate in the Academies of Vienna, Milan, Brussels and Berlin.

AN observant outsider, wise in his generation, has lifted his voice in protest against the rebuilding of St. Thomas's Church, New York, upon its present site,

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and his argument, if not quite canonical, has a certain worldly good sense about it that entitles it to consideration. He argues that very shortly, owing to the advance of commercial interests up Fifth Avenue, and the recession before this advance of the residential centres, St. Thomas's, if rebuilt, will find itself deserted and unfashionable, as have so many other churches farther down town. This disadvantage may, however, remain only a possibility; but what is a certainty, from his point of view, is the fact that the site is too small to provide for a church properly planned to accommodate the audiences called out by those social functions whereat the world and the church shake hands—the fashionable wedding. Taking the times we live in as we find them, we believe the point raised is well taken, and, if the clergy and the vestrymen consent that the church shall be made the scene of these worldly parades, common-sense and decent courtesy require that the church fabric should be arranged for the spectacle, and every one, we believe, will agree that the most important change in plan required would be the comparatively simple one of providing a practicable and commodious carriage-porch, one sizeable enough to accommodate at least two carriages, or three automobiles at a time. It is curious that the modern architect so rarely provides his churches with a carriage-porch, except in the case of picturesque country chapels, planned with no particular regard to ecclesiastical precedent; but there is a real need for these utilitarian adjuncts, not only for weddings and funerals but at all times, and it is evident that the present site of St. Thomas's is too small to provide properly for its congregation and their legitimate comfort.

THE Circuit Court of Ohio has brought perturbation to the spirits of the trustees of all Carnegie libraries that have been erected in that State. The decision comes about through the action of certain citizens of Lebanon, who were unwilling that their town should be bound by the conditions which Mr. Carnegie, *more suo*, exacts in all cases, for the sake of providing for the libraries' up-keep and the perpetuation of his own good name. These objectors pointed out that the so-called "Burns law," enacted not long ago, forbade the making of contracts by towns for any expenditure of money not actually in the town's treasury at the time the contract is made. As Mr. Carnegie's ordinary agreement binds the town to support the desired library in perpetuity, it clearly contravenes the Ohio law, to which appeal has been made, and Lebanon certainly will not have a Carnegie library, unless the terms are changed.

MAYOR DUNNE, of Chicago, has decided that the possibility of serious disaster to abutting buildings through the burrowings of the builders of the freight-tunnels in that city is too real to be disregarded any longer, and consequently has ordered that work upon a large part of the system shall cease, until the contractors can satisfy him that they will adopt a method of excavation and construction that will positively preclude further damage. It speaks well for both the skill and conscientiousness of engineers and contractors alike that so considerable an undertaking, conducted without any public supervision or the enacting of any special ordinances prescribing safeguarding limitations, should have been carried on during a term of years without causing, under such conditions of soil and load as exist in Chicago, serious injury to abutting property. The audacity of the operators is instanced by the fact that ten miles, at least, of the tunnel are said to have been built without any permit for the work having been issued.

A VERY curious case involving a claim for fire-insurance has just been decided on appeal in a Kansas court, which, as architects have all sorts of conundrums propounded to them, it may be well to record. It seems that the mills and storehouses of the Kansas Woolen Company, at Topeka, were invaded by a flood and submerged for eight days. Owing to the amount of wool that had been soaked, it was not possible to give all of it the prompt attention it needed during the process of drying-out and, as the outside temperature was very high, spontaneous combustion was speedily established and the wool, in spite of all efforts, was finally consumed. As the stock was covered by a fire-insurance policy, it was very natural that a claim should be presented for reimbursement. But the insurance company, while admitting that the stock was consumed by combustion and that fires are also a form of combustion, held that the loss was not due to that particular kind of combustion which it assured against, since the combustion did not generate enough heat to produce the external indication of a fire, did not produce "visible signs of heat" as the court expressed it in upholding the contention of the insurance company, and this view was accepted by the higher court. The principle seems to be a fair one, for, otherwise, it would seem to be possible for one whose property had been consumed by the combustion set up, say, by a mordant gas, to claim indemnification under a fire-insurance policy.

IF the New York *Herald* may be believed, a new peril may sooner or later be added to those which now beset the mariner who approaches or skirts this particular bit of sea-coast. It is reported to be the intention to erect "in one of the parks of Manhattan or in some equally prominent spot" a reinforced-concrete tower one hundred and forty feet in diameter and twelve hundred and fifty feet high, the object being to make an income from the elevators, theatres, cafés and amusement centres that it is hoped to have in this mammoth chimney that will produce a satisfactory dividend on the two million dollars the structure will cost, millions which are alleged to be practically already in hand. What sort of mischief will be created by the electric lights visible through so unusual a radius can only be guessed by the skippers of coasters who, even now, have to be on the alert to avoid disaster because some newly instituted private electric light ashore has, since the last trip up or down, come to play hob with some long-familiar "range." Why can't the promoters of such monstrosities as this be contented with a public acknowledgement that their scheme *is* practicable and let it go at that?

FERRO-CONCRETE IN BELGIUM.[1]

FERRO-CONCRETE is a material which was unknown to the general public a few years ago, but has now entered with phenomenal rapidity into all branches of constructional work. This result is due to its remarkable properties, which may be stated as follows:

(1) The economy rendered possible by its use as compared with other systems.

(2) Its resistance to fire, which is now put beyond doubt by numerous tests, some made for the purpose and others the result of accident. It is, moreover, the only flexible material which possesses this quality of fire-resistance; and after the results of the disastrous fire at Baltimore it is clear that very little confidence can be felt in the use of metallic frameworks covered with thin coatings of refractory materials.

(3) It is unaffected by atmospheric action. Concrete is from this point of view comparable with stone of the best quality, and it improves with age. As to the metal built into the concrete, it has been proved that it is perfectly preserved without loss of weight, and that even if used in a rusty state it will recover after some time the bluish tint which it possessed when leaving the rolling-mill. This almost incredible result is due to a chemical action of the cement and probably to the formation of a protective coating of silicate of iron. Concrete also resists equally well the effects of corrosive fumes and liquids which are feebly acid. It may be used for marine works if the proportion of cement employed be high.

(4) The ease with which the material may be made to take any desired form. While preserving the architectural appearance of stone, a boldness in construction may be attained which is impossible with the latter material. It is merely necessary to measure the materials precisely; an error can be corrected during construction and unforeseen details can be improvised. This adaptability is specially valuable in dealing with existing structures.

(5) Its homogeneity, and the mutual support which neighboring parts give in resisting concentrated loads. Joints are no longer weak places. Girders which cross pass through each other without a break. Monolithic constructions are rendered possible which are far more resisting than others to secondary stresses.

(6) Its rapidity of execution. The constituent parts are merely raw materials requiring no previous preparation, and therefore procurable without delay. The individual importance of the single parts is negligible, thus rendering them easy to obtain, transport and erect. Night-work also does not occasion the noise caused by riveting.

(7) Its impermeability, if it has been "floated" immediately after construction in a careful manner. Under such conditions it may be used in the construction of flat roofs, reservoirs, sewers, etc. The monolithic structure which is also watertight may be produced without crack or re-entering angle, so that it can be freely washed down with the hose. Such a structure is essentially hygienic.

(8) Its great rigidity and the localization of the effects of shocks.

The material is an agglomerate of hard stones bound together with cement. As cement is expensive and contracts considerably, it is of advantage to use the least possible quantity by reducing the volume of the voids between the pieces of stone. This result is obtained by using a mixture of materials of different sizes, such as gravel and sand. Moreover, in order to disperse the cement with great certainty equally through the mass, it should be mixed with sand only. Instead of gravel, granite chips, the refuse of the quarries, may be used with advantage. Although these chips cause more voids they, nevertheless, give a tougher product, owing to their angular form, which increases the adherence. Granite dust may also be used instead of sand. The choice of cement is of the utmost importance, and in order to be quite certain it is desirable to use only Portland cement of a well-known brand; according to the nature of the work, the concrete contains from 350 to 700 pounds per cubic yard.

In systems of construction where the metal framework can carry by itself the whole load, and where the concrete is merely intended to protect the metal, to fix it, and to hold its different parts together, then the quantity of cement may be reduced to the minimum and the gravel may be replaced by slag or by coke-breeze. Such concrete is far weaker than the other, but it is less expensive, lighter, more refractory and more sound-proof, and nails can be driven into it.

At the present time the metal almost exclusively employed is mild steel with an ultimate tensile strength of 27 tons per square inch. This costs no more than iron, and has the advantage of possessing a greater tensile strength and a higher coefficient of elasticity than the latter metal.

Round bars are generally used, as they facilitate the escape of air and the proper ramming of the concrete; they also possess no sharp angles which would cut the concrete; but, on the other hand, the round section gives the lowest coefficient of adhesion for a given cross-section of metal.

The construction of the centering is the most important part in the erection of structures in ferro-concrete. It takes up the most time and seriously enhances the cost of the work. In the design of the centering the contractor has an opportunity to exercise all his ingenuity; to use wood which can be again employed and to avoid cutting the wood into short lengths and so causing waste of material. If vaulted forms have to be constructed the cost of the centering may be greater than that of the ferro-concrete itself.

Certain systems reduce or even obviate altogether the use of centering by the employment of metal work of sufficient strength or pieces of concrete specially made for the purpose. Mouldings as a rule are roughly formed in the concrete by centering, and then finished in gauged work; but the latter is a difficult process, for the neat cement takes some time to set and is not sufficiently plastic.

It is not possible by a simple examination to ascertain the strength of a finished structure in ferro-cement, for the metallic members are no longer visible and their precise size and position cannot be gauged. The only method is to measure the deflection of the structure under given loads. The results obtained are, however, not precise, and useful information can only be gained by comparing similar structures. The deflections of structures in ferro-concrete are much less than those which would be given by a structure of equal strength built of wrought iron; for when concrete is stressed up to its elastic limit its deflection is less than that of iron under similar conditions.

Professor Rabut has summed up in the following six rules the principles which experience and theory recommend should be followed in the construction of ferro-concrete buildings:

(1) No connections should be made of iron to iron, as the concrete itself holds the parts together in the most economical manner.

(2) At least two distinct systems of reinforcement should be used—the one system to take up the tensile stress and the other to take up the shearing stresses in the concrete; when it is necessary a third system should be used to take up the compressive stresses.

(3) To so arrange the reinforcement that the separate members may be stressed in the direction of the length, so that the stresses produced between the iron and the concrete shall be tangential and not normal to the axis of the members of the reinforcement.

(4) To profit by all means of increasing the homogeneity of the various parts of the structure. This may be done by prolonging the iron parts of one portion of the structure into the thickness of the concrete of the adjoining portions, at a negligible cost, while the construction of rigid joints in a metallic structure is very expensive.

(5) On the other hand, advantage should be taken to the utmost extent of the homogeneity thus obtained to economize materials.

(6) In view of this homogeneity sudden alterations in the cross-section of the parts should be avoided, as the parts tend to assist one another and to distribute the stresses, the constitution of ferro-concrete being, so to speak, democratic.

The component parts of a ferro-concrete structure may be classed under three headings, which the author will examine in turn. They are (1) the parts which resist tensile stresses, (2) those which resist compressive stresses, and (3) those which resist more complex stresses.

These comprise chiefly the beams and the platform beams. In the majority of cases the beam supports a platform which is solid with it, and can therefore be used as a framework in compression; and this is one of the most characteristic properties of ferro-concrete. The beam is therefore really composed of the rib and the part of the platform on each side, and this has a cross-section in the form of a T. The tension member consists of one

[1] A paper by M. Edouard Noaillon, read before the Liége meeting of the Institution of Mechanical Engineers, translated for and published in *The Builders' Journal.*

or of several metal bars embedded in the lower part of the rib.

The materials are therefore used in the most rational manner, the concrete of the platform is subject to compression and the metal resists tension; but this specialization of work is only possible, owing to the adhesion of the concrete to the metal. In reality there are forces tending to produce sliding, and these are proportional to the shearing forces, and therefore attain their maximum value near the supports. These forces tend to shear the concrete of the rib and are concentrated at the contact surface of the concrete and metal. The mutual adhesion of these two materials has a very great importance, and it is well to bear this in mind.

Numerous tests have shown that in a carefully built structure this adhesion is not of lower value than the shearing coefficient of the concrete itself. If, however, the concrete be very poor in cement, or if it has been gauged too dry and insufficiently rammed, then the adhesion may be low and the use of bars of special section has advantages, these bars having projections which prevent all slipping of the metal in its concrete sheath. Such bars are very commonly used in American practice.

It has been stated that the adhesion was illusory, and that in reality the effect was merely due to a high coefficient of friction between the iron and the concrete which compressed it in shrinking. But the fact that beams subject for lengthened periods to incessant vibration, such as those in the floors of flour mills, have remained sound tends to prove that the adhesion is real and lasting. Special tests have always given reassuring results, except when they have been made upon flat contact surfaces; but this is a condition which does not occur in practice, and it is probable that during setting the contraction of the cement produces tangential stresses which destroy adhesion as it is produced. In the case of cylindrical surfaces, on the contrary, this contraction produces compression normal to the axis of the cylinder and therefore favorable.

Adhesion does not only assist in resistance to shearing stresses, but the variations in relative volumes of the two materials in contact must be considered; these variations being caused by change of temperature or by shrinkage of the concrete.

Temperature has no influence, for the coefficients of expansion of iron and concrete are practically the same. When concrete sets in air it contracts, and therefore may produce considerable initial compression upon the embedded metal, while being itself subject to an equivalent tensile stress. When the concrete sets under water the opposite effect is produced; the concrete expands and puts the metal in tension.

It is important that the shearing stress should neither overcome the adhesion of the metal to the concrete nor shear the rib of the beam. To fulfil the first condition it is necessary to form the metal framework of such a number of bars that their surfaces in contact with the concrete shall be large enough, and, in consequence, the chance of surface slips shall be reduced. To avoid shearing of the rib special stirrup-shaped bars are used which join together the two members. It is not correct to state that these stirrups directly resist the shearing stress. In reality, a piece which is under shearing stress throughout its entire length is by that stress subject to bending, but the stirrups have no rigidity and are incapable of resisting any appreciable bending moment; as a matter of fact, they fulfil the same purpose as the tension bars in the web of the lattice-girder; the duty of the compression bars is fulfilled by the concrete of the rib. It is therefore obvious that it is essential for the stirrups to be hooked at one end to the tension bar, and that at the other end they should be solidly embedded in the concrete platform. Fig. 1 shows the

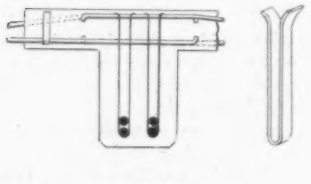

FIG. 1.
SECTION OF HENNEBIQUE BEAM AND STIRRUP.

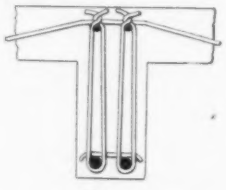

FIG. 2.
SECTION THROUGH A COIGNET BEAM.

transverse section of a beam built on the Hennebique system and beside it the drawing of a single stirrup. This stirrup consists of a flat, bent bar with the two ends bent in the form of claws, allowing it to hook itself solidly into the floor structure. The use of the flat bar in preference to the round bar facilitates the construction. Fig. 2 represents a cross-section of a beam on the Coignet system. Here there is an upper iron framework. Owing to this it is possible to put the framework of a beam together in advance, and to place it in position entire while holding it by the upper bar. The attachments are made of bars of round iron bent to U-section, and the ends are twisted together so as to form an elongated ring. Owing to the presence of the two frameworks the attachment binds the two members together very effectively. The round section is better suited to the concrete than the rectangular form.

Another means of resisting sliding consists in omitting horizontal bars in tension and substituting bars fixed obliquely in the webs and rising to the floor structure at the ends of the beam. In this manner a beam of variable height is obtained approaching more or less closely to the parabolic form—that is to say, the ironwork will be subject to a constant tension upon its entire length, and the shearing stress will be zero, as it is neutralized by the vertical component of the oblique tension in the bar. In this manner, however, the difficulty is only set back a step, for the bar being in tension right up to the ends, must lose it rapidly in a very limited space, whence arises a considerable tendency to slipping, which is met either by opening out the end into a swallow-tail, or, if this is insufficient, by bending the bar upon itself and placing a cross-pin in the bend. The simple oblique bar is not used for a beam with free supports.

The author has pointed out that one of the characteristics of concrete is to lend itself easily to continuity of structure; but it is clear that this may have the effect of displacing toward the bottom the diagram of the bending moments in such a way that near the supports certain reversed moments may be of higher value than the moment at the centre of the span. From this cause tensile stresses are produced in the top member and compression stresses in the bottom member. In order to overcome the first set it is necessary to provide new reinforcement if it does not exist in the upper member, or to raise the lower reinforcement toward the top of the beam, which has also the advantage of neutralizing the tendency to sliding, as has already been pointed out. To overcome the second series the concrete of the lower part of the web is often insufficient, and then the lower reinforcement is used at this point in compression. Another method which is coming into use consists of banding the concrete of the web, which, as will be pointed out hereafter, considerably increases the resistance to crushing.

When the reversal of the moments is due to the continuity of the beam and the floor platform the use of reinforcement in the upper part is not always necessary; in fact, the platform may then play the part of the member in tension, owing to the "distributing" bars which it contains and to the resistance to tractive efforts of the ferro-concrete itself, which will be discussed later.

When the beams have no continuous platform at their upper part they ought to be provided with comprehensive reinforcement or be banded.

Fig. 3 is a longitudinal section of a portion of a beam on the

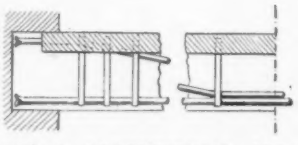

FIG. 3.—LONGITUDINAL SECTION THROUGH A HENNEBIQUE BEAM.

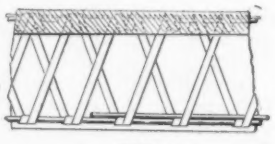

FIG. 4.
PERRAUD AND DUMAS BEAM.

Hennebique system. It will be observed that half the bars composing the lower reinforcement rise to the top at the supports, resisting at the same time the tendency to slide and also the moment of shearing at the junction. The other half keep their position right to the end, where they serve to resist the compression and to support the stirrups.

Fig. 4 represents a portion of a beam built upon the system of Perraud and Dumas. The attachments are formed of a trellis of flat strips bent obliquely between the lower reinforcement and a bar at the top, so that the body of the beam forms one mass of great rigidity which is of value in the erection. The lower ironwork is reinforced in its central part by a bar in order to obtain as nearly as possible a section of canal resistance [*sic*]. This method has, however, the disadvantage of giving a minimum perimeter to the section of the ironwork at the supports, which are precisely the points where it should have its greatest value. At the level of the platform there are bars to resist shearing at the supports and compression bars in the centre.

The author of this paper desires to advocate a simple system which affords a reinforcement of canal resistance and offers every security for resistance to sliding. Fig. 5 shows its application to a beam without fixed ends. For a span of moderate amount the reinforcement consists of bars of three different lengths.

It will be seen that they leave the lower part of the web at determined distances and rise toward the floor structure, where they end in a hook. In these hooks, as well as in the angles formed

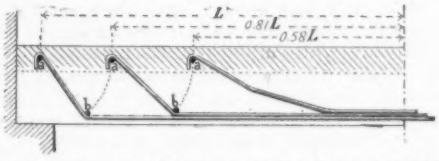

FIG. 5.—BEAM RECOMMENDED BY THE AUTHOR.

by bending, there are placed transversely pins *a* and *b*. These pins are of great importance, for they represent the placing, between the oblique parts, of bars which may be considered as the diagonals of the web of a lattice-girder, and the concrete lying between *a* and *b*, which is analogous to the compression bars.

The reinforcement of a beam with platform is calculated according to the nature of its central transverse section where the maximum bending moment occurs. As the sliding efforts there are zero, the normal sections remain flat after deformation and merely swing upon the neutral axis. This condition of conservation of the plane sections, combined with the equations of equilibrium of movement and of moments, suffices to determine the forces acting upon the reinforcement. But for this it is necessary to know the law which connects the compression of the concrete to its decrease in length. This law, however, varies within wide limits according to the composition of the concrete, and especially with the manner in which it is used in the work, the degree of fluidity and the ramming. Moreover, the law is not linear and is greatly affected by hysteresis, so that the deformation is a function of the duration of the compression and of the former life history of the concrete, so far as stresses are concerned. Yet when the height of the beam is great relatively to that of the floor platform the variation of the law of deformation of the concrete does not sensibly affect the forces acting upon the reinforcement, and the section of the latter may be calculated with sufficient accuracy.

It should be noted that the elements of the floor platform which constitute the reinforcement in compression have an efficiency which diminishes as their distance from the web increases and as the length of the beam decreases.

When in a beam of **T**-section, the part of the concrete in tension in the web has merely an insignificant influence and may be neglected, it is desirable to inquire if it is not the same with the concrete in tension, in a floor platform which has a section larger than that of the concrete under compression. M. Considère has shown that ferro-concrete can extend without cracking until the reinforcement reaches its limit of elasticity, and that the part of the resistance due to the concrete attains after the first extensions a value which remains constant until rupture occurs. It is evident that if this result is to occur the piece must be free from all cracks before the test, and to obtain this condition special precautions must be taken in its manufacture and setting. Excess of water must be avoided in gauging, ramming must be carefully done, and the piece must be kept moist during the first days of setting.

In practice these conditions are never fully realized, and therefore the rapid shrinkage of the cement produces premature tensile stresses which cause hair cracks. But these cracks never affect any great depth of the floor structure, and many contractors think that one may therefore count upon almost the whole of the concrete in tension to relieve the reinforcement; others, on the contrary, believe that it is always dangerous to count upon this aid.

The tension of the reinforcement of a platform will also vary with the law of deformation which it may be thought desirable to apply to compressed concrete, a law which is all the more uncertain, as concrete is not homogeneous; in fact, the last layer of concrete is not generally rammed so as to facilitate leveling. It is therefore obvious that the theoretical calculation of floor structures can only have a relative value, and that the coefficients which are used in these formulas ought to be obtained from practice. This uncertainty in calculation is, besides, often hidden by the want of precision with which the reinforcement can be fixed in the thickness of the platform.

Like the beams, the platforms are very often fixed or continuous, and this condition requires reinforcement in the upper layer, or in a simpler manner by the raising of the lower reinforcement near the supports (Fig. 2).

With respect to resistance to sliding, as the perimeter of the section of the reinforcement is almost always less than the width of the platform, it is useless to provide stirrups. Besides the principal reinforcement, there are placed immediately above it, and in a perpendicular direction, some "distributing bars" which are intended to interlace with several of the principal bars and offer a better resistance to a concentrated load. In order to insure regularity of erection the two systems of bars are sometimes bound together at some of the crossing points by means of iron wire.

When it is a question of covering a surface approximately square—a case which occurs frequently in houses—there is a great advantage in making the two systems of bars of equal strength so as to make use of all four sides of the space as supports.

The uncertainty of the condition of stress upon the reinforcement which is so great for the ordinary floor platforms is still more so for the square surfaces referred to above. The reinforcement may be fixed in lines parallel to the sides or parallel to the diagonals; the use of the latter system, which necessitates a large number of different lengths of bars, cannot be justified by any theoretical consideration; a satisfactory system consists in placing the reinforcement parallel to the sides and grouping the bars close together along the middle of the sides.

A simple and elegant arrangement for surfaces of small dimensions consists in the use of expanded metal as the reinforcement; perfect security is then obtained for the necessary adhesion, and a poor concrete may be employed. This method of construction can be recommended for foundation blocks.

Columns are usually made of square section to facilitate centering; as a rule, the reinforcement consists of four longitudinal bars placed near the four angles and joined at intervals by cross-ties. The ties are intended to prevent the buckling of the individual bars, and also serve to retain them in position during the filling of the concrete. The cross-ties consist of plates or round bars which surround the longitudinal bars. Sometimes they are twisted round each bar, or plates with holes may be threaded upon the bars.

The calculation of the reinforcement is empirical, for the determination of the strain is first of all affected by the uncertainty regarding the law of deformation of the concrete, since it is directly proportional to the latter. Besides this the shrinkage of the cement communicates to the metal an initial compression which is very considerable but impossible to value beforehand. Moreover, the bars also assist in resisting the tendency to buckling of the entire column, but the buckling is proportional to the coefficient of elasticity of the column, and this value varies with the load and is very different for the same load according as the preceding load has been greater or less than the load under consideration.

The resistance to buckling and to crushing is much increased by the use of a concrete very rich in cement, gauged with only a small quantity of water and well rammed.

The methods of reinforcing concrete against compression have been revolutionized by the introduction of the banded concrete invented by M. Considère.

The very remarkable work of M. Considère has shown that metal employed under the form of bands has, from the point of view of resistance to compression, an efficiency 2.4 times greater than that used in the form of longitudinal reinforcement. To be effective these bands ought to be circular and should not be placed further apart than one-seventh of the diameter of the banded concrete. By submitting the banded pieces to an initial compression or letting them harden under water the bands become also much more efficient than longitudinal bars in resisting buckling. They have also the considerable advantage of being endowed with an absolutely surprising elasticity, which makes a thoroughly sound structure. Warning is also given of excessive compression by the shelling off of the concrete covering the bands long before the structure has reached its safe limit of compression.

The simplest and most economical form of the bands is the spiral. By putting the turns of the spiral closer together it is possible to strengthen certain parts which are under the greatest stress and give a known increase to the strength. It is also possible to reinforce a structure already completed by winding round it an iron wire which is afterward covered with a layer of plaster. Banded pieces prepared in the workshop with all

possible care, and made with a very rich concrete and subjected to initial compression offer a resistance to compression comparable with that of a structure of riveted steel of the same weight, and are less expensive.

It is safe, therefore, to prophesy that banded concrete will be able in a large number of cases to replace with advantage the compression members made of rolled steel sections in a large metallic structure. The tension members would consist of bundles of round bars lightly banded and dipped in concrete. The connections would be more easily made than those of other frameworks, and could be reinforced by a supplementary banding. Such structures would have an unlimited life with practically no expense for maintenance. In this connection M. Considère has constructed and tested with complete success a bridge of 65.6 feet span entirely built of banded concrete.

An important application of banded concrete has come into ordinary use for piles. Such piles are stronger than those of wood, and have the enormous advantage that they do not rot.

The most important type of these pieces is the vault, in which the reinforcement is specially designed to resist bending stresses caused by non-symmetrial or concentrated loads, while the concrete supports in compression those that are fixed and distributed.

The greatest uncertainty exists as to the most rational method of reinforcing a concrete vault; the calculation of the reinforcement is only rendered possible by the use of empirical coefficients. For vaults of wide span one observes that different builders follow opposite methods; some, like Hennebique, thinking that the essential character of ferro-concrete is the opportunity which it gives for producing monoliths and of profiting in all cases of possible banding, form their vaults of a series of ribs in arcs connected at their upper parts by a horizontal platform; the arc has then near the supports its maximum of height, and this permits a good banding with the abutments. Other builders seem to be haunted with the fear of the effect of expansion and of shrinkage, and give to their vaults as much flexibility as possible by making them with a cylindrical lattice-work. In recent years some have gone farther in this direction and formed arches with three joints.

As has been seen from the preceding remarks, it is most frequently impossible to determine accurately by means of theoretical formulas the actual cross-sections of the reinforcement. The best guide is experience, translated as well as possible into empirical rules. These rules will be all the more reliable according as they are based upon a larger number of structures, and from this point of view it is best to prefer the systems which have been the most employed in practice.

On the subject of principles of calculation for structures in ferro-concrete it is interesting to cite the opinion of Professor Rabut: "I often hear it said that structures in ferro-concrete cannot be accurately calculated as metallic structures; in my opinion the contrary is true; the formulas for metallic bridges are in their principles just as arbitrary and just as far from the expression of the real strains as those of ferro-concrete; but the latter have the advantage of containing twice as many constants, those of iron and those of concrete, which, if these constants are conveniently chosen, will allow of approaching the truth much more nearly."

The author will now briefly describe some types of constructions in ferro-concrete which present interesting features, and will restrict his choice to recent works and those to be found by preference in the neighborhood of Liège.

The dome of the Central Railway Station springs from the level of the roofs of a mass of buildings of the station at a height of 130 feet above ground level and rises another 130 feet to the spire. It is entirely constructed of ferro-concrete by the firm of Vasanne, of Brussels. The work was originally intended to be built in stone, but it was discovered that the foundations would not carry such a weight, and therefore ferro-concrete was preferred, as it could be built hollow. However, it was necessary to follow minutely the form of the original design, which, rationally conceived for a massive material like stone, often presented serious difficulties of execution in ferro-concrete.

The dome comprises four large glass lights placed upon the sides of a square, and upon these rests the actual dome, which in its turn supports a lantern. Each glass light is in the form of a gallery with seven arcades surrounded by an arch of 32.8 feet radius. The arches are framed by an archivolt of 11.5 feet height, which receives at its periphery the haunches of the dome.

The entire structure, which is 1,800 tons in weight, rests entirely upon the columns at the angles of the glass lights, for it was only at these points that a solid support could be obtained. These columns are Y-shaped in the cross-section, which has an area of 10.7 square feet, and they are subdivided at the height of the centres of the arches into three beams.

The tail of the Y is extended in the diagonal plane in the form of a thrust block, rising obliquely between the two shells of the dome. Each of the limbs of the Y forms the abutment of the beams in the arch, 8.2 feet high, situated in the archivolt. In the horizontal plane passing through the tops of the archivolts is placed a beam in the form of a flat ring 4.92 feet wide, which is supported at eight equidistant points, which are the four tops of the archivolts and the four ends of the thrust blocks.

This beam serves two purposes—it balances the horizontal reactions, due to the obliquity of the thrust blocks, and resists the tensile stress created by the joists of the dome. At the top of each beam of the archivolt are hooked two tie-rods, which go down in the two midribs of the arches and extend into the two central columns of the gallery of arcades and support in its place a horizontal beam hidden in the entablature of the gallery and supporting all lights; it is obvious, therefore, that all the weight of the latter is supported by the columns.

The dome consists of two superposed shells at a distance apart, varying from 3.28 feet to 6.56 feet. The internal shell which forms the ceiling of the entrance hall is completely decorated with sunk-moulded panels; some are round and others square, and they diminish in depth and size progressively from the springing to the summit.

They leave only flat bands on the inside of the shell, and these follow a series of meridians and parallels. A part of these flat bands are formed by a skeleton of joists and trimmers which are supported on the annular beam, and they carry the whole weight of the dome. This skeleton was first erected and served to support the cores which formed the moulds for the panels, and then the latter were filled in with concrete.

The external shell has a uniform thickness of 3.15 inches, and it is relieved by six moulded ribs following meridian lines. It is supported upon the internal shell by small distance pieces normal to the two surfaces; this method of support has been chosen to allow as much freedom as possible for the unequal expansion of the shell, owing to the rays of the sun striking it obliquely.

The most interesting feature of the construction of the dome of the Antwerp station is that all the mouldings and all the sculptures, which are so numerous and of so many different forms, have been executed by direct moulding, and not, as is usually the case, by rough applications which are trued up afterward by gauge boards. It would never have been possible to make in wood the numberless moulds which would have been needed for the latter process, particularly as the work had to be done upon surfaces bent often in two directions like the panels of the dome.

M. Vasanne has invented a very ingenious system of moulding. He begins by executing in plaster the model of the sculptures which are to be reproduced in the concrete. He then spreads upon this negative mould a layer of 1.2 inches to 2 inches thickness of a paste made of sawdust and magnesium oxychloride. This paste hardens rapidly and gives him the desired mould, which is light, strong and can be worked like wood; the same negative mould can be used several times.

The Renommée Hall at Liège was built entirely of ferro-concrete by the firm of Perraud & Dumas, of Brussels. In opposition to what took place in the design for the dome at Antwerp, the general arrangement, the style and proportions of all the parts of the building were specially thought out by the architect, M. Jaspar, so as to be the most suitable for construction in ferro-concrete, and in order to use the properties of that material to the best possible advantage. It was desired to oppose the tendency to make concrete merely play the part of a servile imitator of stone by the employment of a characteristic design which should indicate the nature of the material used.

The principal hall is covered by three cupolas, each 55 feet diameter, placed at a height of about 50 feet above the level of the ground. Each cupola forms part of a sphere which continues in haunches pierced with lights and descending to the corners of the circumscribed square. The intersections of the spheres with the vertical planes passing through the sides of the squares are formed by arched beams which spring from the capitals of short cylindrical columns. The cupolas are 4½ inches thick and are made of concrete composed of cement and clinker finely broken up; they are reinforced by a layer of expanded metal and with a lattice-work of bars. The centering of the first cupola was carried out upon a new design. In order to avoid the great expense entailed by the construction in wood of a spherical cen-

turing, a skeleton was built up of ironwork consisting of 16 bars, each 1½ inches diameter, fixed upon the meridian lines like the ribs of an umbrella, and these were interlaced upon parallel horizontal circles by other weaker bars. The whole skeleton was then covered with sheets of expanded metal, which were designed as the first reinforcement, and afterward the concrete was put on above and below so as to completely surround the expanded metal, which thus acted as its own centering, and it was merely necessary to render the surface up to the required thickness. The bars of the skeleton were then to be removed and used for the other cupolas, and they were finally intended for reinforcing the beams. Unfortunately, this system of centering was found to be wanting in rigidity, and it was necessary to use the wood centering after all.

The roof of the galleries and the spherical triangles between the cupolas form a terrace of 957 square yards area, which serves as a promenade. The concrete of the cupolas and the terraces is not rendered in cement; it is made watertight by a layer of Ruberoid. The principal hall is lighted upon its two long sides by six semi-circular glass lights, each 52.5 feet diameter, framed by arched beams. The spandrels are formed by panels of ferro-concrete, showing on the inside ornament in relief; the moulding was done in the workshop, and then each panel was cut into portions that were erected in position. In spite of the complete absence of mouldings, which were left out to facilitate the centering, the hall is of most elegant appearance.

This company, under the advice of its managing director, M. L. G. Fromont, who is an engineer, has adopted the system of reinforced concrete for the construction of various foundations and for the construction of tunnels, cellars, platforms, hoppers, silos, frameworks for all lead chambers and for various powers, such as are required in the Glover and Gay Lussac processes. Among the interesting applications should be specially mentioned the framework for lead chambers.

It is known that the most modern constructions designed to shelter and support the lead chambers are essentially composite structures, generally made of brick in the lower portion and in iron and wood for the upper portion. The combination and connection of the various heterogeneous parts present many weak points for attack either by the sulphur gas or by sulphuric acid when an accident has happened. Besides this, the enormous quantity of wood used for this kind of structure makes them highly combustible and exposes the manufacturer to serious risks. These disadvantages alone suffice to justify the use of ferro-concrete, and the structure built at Engis, from designs prepared by M. Faure, under the guidance of Prof. Henri Deschamps, constitutes really a monolith from the foundations to the summit without joints or discontinuity.

From the point of view of resistance to gas and acid liquids, the composition and treatment of the concrete has been the subject of special study, and the mixtures employed have given perfect satisfaction.

The structure occupies in plan an area 230 feet long by 92 feet wide; it has a total height of 82 feet, of which 23 feet is for the lower portion and 59 feet for the upper part. The lower portion is formed of piers placed 16.4 feet apart, each consisting of four columns connected at their upper ends by a horizontal girder 92 feet long aided at various points by struts fixed to the base of the columns. The total load carried by the lower structure is about 3,700 tons. At certain points the girders are connected together by joists, and there is a flooring of ferro-concrete which serves as a footway all round.

The superstructure consists of vertical columns 59 feet high, which rise from the ends of each horizontal girder, and besides these there are also columns in the centre of the building. At the upper part all the columns are connected together by horizontal girders with a span of 44.5 feet, and each of these bears a distributed load of 45 tons. The horizontal connections of these girders form the roof terrace. The columns are solidly connected together by vertical partitions of ferro-concrete, which, in conjunction with various struts, give the desired rigidity to the entire structure. The building was erected in 1900, and since that date has been in constant use and has given no trouble whatever. Owing to the careful distribution of the materials it has not been more expensive to construct than the old unsatisfactory composite buildings.

JAMESTOWN RESTORED.

IT is a rather amazing fact that this most notable spot in our whole country is always referred to in terms of the dank marshiness that should have kept the English from landing there. The histories, when they give illustrations on this head, seem to have only the church tower and a caving river-front in mind. Even Fiske and Winsor give you no more than this. And Winsor, with curious economy, affords only a drawing of the tower made by an English lady in 1857.

From the mainland, the approach to the island is, for a pedestrian, peculiar. The road from Williamsburg, after wiggling its devious way through a beautiful but mostly deserted country, finally brings you in sight of a river, to the left; then it dips behind some trees, and in another moment you are traversing a level space, the road strewed with probably historic bricks; sedges and grasses shoulder-high on each side let you see only some of the towering trees on the island in front. Suddenly you strike a narrow bridge, and find that your level road is barely two feet above the water. But the island, when you get to the end of the bridge, appears anything but swampy, and it is some little distance farther on that you discover you have landed on one of the four "ridges" and still have some low land to cross. From the James River, the side from which the colonists approached, the island is very attractive. The whole south side presents now a nearly level, grassy expanse, delightfully set with lines of fruit trees from among which rises the picturesque ruin of the Ambler-Jacquelin mansion. Tradition has it that here George Washington met his first defeat—the lady would not marry him! Sycamores and mulberry trees stand along the shore, which is an abrupt bank, at least six feet above water, and for most of its length has below it a narrow, sandy beach, running off nearly a mile to the southeast, where the point of Goose Hill juts out. West of the pier, which stretches far into the river, the land rises a little in the neighborhood of the old church, and the trees are thicker.

Besides the discrepancy between the look of the island itself and what has been written about it, the most interesting facts, which are new, have apparently not got into print at all, except lately in one historical magazine that probably hasn't five thousand readers in the whole country. Don't fear, however, that I am going to "recall that on a morning of early May in the year 1607," etc. I can, but will not, name to you some well-known journalists who have come here only to suffer shipwreck on that day in early May. Besides, Jamestown has now a bit of modern history, or rather of archæology, that is little known, and especially deserves printing because it has led to correcting our accepted history, including even the work of so high an authority as the beloved John Fiske.

William Leal, Scotch stonecutter, constable, custodian and postmaster of the place—the Schliemann of Jamestown—it is who plastered and patched up the remnant of the church tower, who dug up and put together the ruined tombs and uncovered the foundations of the church and other buildings of the early days. He has had a curious connection with important work since he came to America in 1871. First he worked in Maine, cutting stone for the then-building post-office in New York City. Then he worked for a time on the Capitol at Albany; next on cotton mills in Rhode Island; and finally he settled in Richmond. Here he soon became known and was employed on the private monumental work of the best people of the city. He also put up many monuments to mark Confederate sites: the big column in Alexandria is a piece of his work. From this it will appear why the Association of the Preservation of Virginia Antiquities has given him nearly free rein in Jamestown. He was appointed custodian by unanimous vote at a meeting of the directors in the old tower, Fitzhugh Lee presiding, and he has deserved well of them and of all who would take pride in Jamestown. If ever you go to Jamestown, cultivate him; he is one of the finest old bits on the island.

Mr. Leal had appeared to me, in the first place, apparently from nowhere, but the mystery was solved when he led the way to his house. The roadway comes down from the north immediately in front of the church tower. On the opposite side, across the road, are high, grass-covered banks well set with trees, and in a gap in the bank is a narrow entrance, latticed and heavily covered with honeysuckle. This opens into the area of the Confederate fort that forty-odd years ago was one of the defenses of Richmond. Inside this enclosure, heavily shaded by trees, is William Leal's house, a story-and-a-half affair; and swarming about are hens, chickens, ducks, young and old turkeys.

The story of the uncovering of the Jamestown relics is a very recent one, but it has been much mangled and distorted by some who have tried to tell it. Among other mistakes, undue credit has been given to the efforts of E. E. Barney, who bought the island some years ago. After the State of Virginia had granted the immediate church and grave plot to the Association. Mr. Barney generously conveyed to the Association 22½ acres of

ground surrounding the church, and including the old Confederate fort. He had tried before this to preserve the tombs, but by a method so unwise as to reflect seriously on his judgment. Many of the stones he had had removed from the churchyard to a safe place, and it is said in his behalf that he had a plat of the yard made at the same time, and numbered stakes set to show the position of each stone. When, however, the Association tried to straighten things out, the supposed plat and stakes were nowhere to be found, and the last degree of certainty as to most of the yard was gone. The need of some such proceeding, however, or the placing of a keeper, is shown by one incident of the havoc done by relic-seekers. A year ago the captain of a barge lying in the river off Jamestown brought his wife over to see the ruins, and he then told Mr. Leal how, fourteen years before that, when his barge was anchored in nearly the same place, her crew had come to the island by night and carried away the big top slab of a tomb, which they broke into small pieces and sold at a huge profit.

In the Jamestown churchyard, the remains of the tombs were in most cases two or three feet below the surface. When Mr. Leal was sent to the island, in 1901, the task of restoring these must have seemed all but impossible. The sites were much in doubt, nearly every top-slab was in pieces, and many of the pieces were missing. There was one exception, still notable—the tombs of Commissioner Blair and his wife, who was a daughter of the original Benjamin Harrison. Between these tombs a sycamore sprang up, and now, a great tree two feet in dimeter at the level of one's head, its enormously expanded base holds the tombs in a resistless grip. The top slab of Mrs. Blair's tomb is now fairly within the body of the tree, two feet above the surface of the ground; on the other side, the tree has already enclosed one of the marble stones of Commissioner Blair's tomb, and has spread halfway over two others, so that only one of the four slabs is now really free.

Excavation of the church foundations was begun in 1901, and three feet below the surface they were found, enclosing an oblong 55 feet long and 26 feet wide, one end joining the tower. They did not disclose walls "three feet thick," as one writer who should have known, has declared; these walls cannot be more than 15 or 18 inches, unless one measures through the buttresses, of which there were three on each side. A little within this wall were found fragments of a much thinner one, presumably the foundation of one of the early frame churches. These walls have now been built up to a level. They are now protected from the weather by a light frame structure which is to be replaced, when money is forthcoming, by a brick building in the style of the old church. The floor, aisles and chancel of the old church were found surprisingly well preserved. How utterly forgotten they had been is shown by the fact that the graveyard wall, built 110 years ago, was carried right across the body of the building.

The chancel proved to be one of the most interesting finds, the first excavation uncovering there a floor of tiles nine inches square; later digging disclosed two other floors under this one. There were evidences of fire here, and on the lowest floor, in a corner, were found the sexton's tools, charred bits of wood showing where the handles had been. It would seem that after the church was burned, during Bacon's rebellion in 1676, the floors must have been repaved above a foot or so of rubbish from the fire. Within the chancel were found a number of graves, laid east and west, with the axis of the building, and one notable find was a skeleton measuring six feet six inches in height. Of two tombstones unearthed within the body of the church near the chancel, one has the distinction of being the only one found in America that has signs of once having borne such inlaid brasses as are seen on old monuments in England. The brasses were gone from this one, but their shape is plainly shown by the channels in the stone, showing the figure of a knight, with pointed helmet and a scroll issuing from the mouth. Partly under the tomb was found a skeleton with spurs at the heels, and scraps of gold lace at the shoulders. The stone bore no inscription, but research seems to show that the knight was Sir George Yeardley, one of the earliest Virginia governors, who died in 1627.

"James Citty," as it used to be, has been restored in large part by the very scholarly research of Samuel H. Yonge, engineer in charge of the concrete breakwater which was partly completed in 1901, and is now being extended over the whole west end of the island. Here it may be noted that the shape of the island is a thing the casual reader is likely not to find in the books, though it might seem worth setting down, if the historians really knew it. Roughly, its outline is a good deal like that of a big oyster shell. It is about two and one-fourth miles long, the main axis lying northwest and southeast, with the narrower end of the island toward the northwest. At this smaller end was the low, tide-washed isthmus that once connected it with the mainland. The present wooden bridge is some hundreds of yards east of where the isthmus used to be. From the spreading southeast margin of the island, behind the high James River front, fingers of marsh stretch nearly across the island. On the northwest, the river has been cutting away the land for some fifty years past, until it has taken off a strip about 500 feet wide. The western margin is still indicated by a big sycamore, now far out in the water; near it, at low tide, are the stumps of twelve others, showing that there must once have been a considerable grove there. John Smith's powder-house was near these, but it has now disappeared.

The present extension of the sea-wall just saved a very important set of foundations—it practically touches them—whose excavation two years ago spurred Mr. Yonge to the best of his research work. These foundations showed the existence of several small, connected buildings. They include cellars and steps leading into them, and the foundations extend 240 feet from the present river edge inland. Mr. Yonge has shown pretty clearly that the most eastern of these was the State House in existence in 1676, in which Bacon contended with Sir William Berkeley. The building next the river was apparently the so-called Country House, and the next that of Justice Philip Ludwell. A human touch is given to these two by Mr. Leal's story of how he found, in digging out the basement of the first, a lady's stirrup, a thimble and a pair of scissors. The other gave up, besides melted lead and an obviously ancient bottle, a number of old cannon balls, the four and five-inch pellets that used to serve for the land pieces of that day.

Mr. Yonge has upset the universal opinion of historians that the old settlement lay mostly west of the church. John Fiske says in "Old Virginia and Her Neighbors" (1896) that more than half of the site of the old town has been destroyed. Careful study and plotting of the old records of land patents has shown on the contrary that the town extended as far east of the church as west, and that it had a total length along the river of three-quarters of a mile. The records also show that the eastern or "New Towne" was of permanent character, and for many years after its establishment, in 1623, was the most important part of the corporation. Mr. Yonge has succeeded in laying out an approximate map of the old town, with its single "Back Street" some 300 to 500 feet from the river. His work is convincing, and should have wider currency than it gets in the Virginia *Magazine of History and Biography*. Its details cannot be even summarized here, but the story reconstructs the past time as no chronicle of famines and Indian fights has ever done. His work could have been done in part before, but it was actually due to the new excavations.—*B. S. Baker, in Boston Transcript.*

ILLUSTRATIONS

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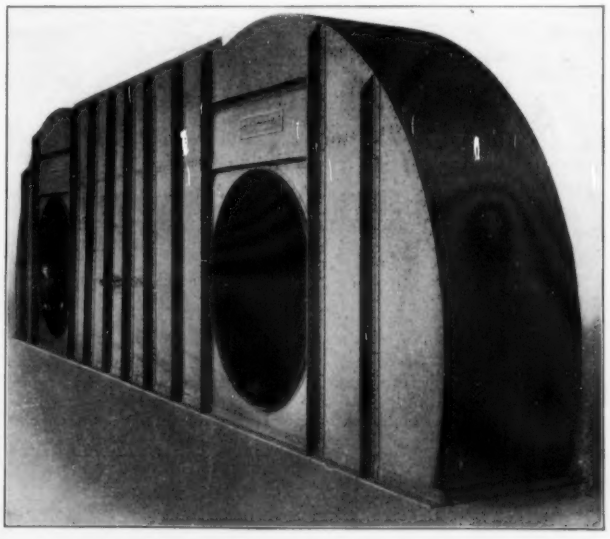

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BUILDING NEWS.

(The editors greatly desire to receive information from the smaller and outlying towns as well as from the larger cities.)

ALLEGHENY, PA.—Ground has been broken for new $50,000 edifice for the Oak Park Presbyterian Society.

ASHEVILLE, N. C.—Frank Loughran and associates propose to form $250,000 stock company to build a hotel. R. S. Smith will be the architect.

ALLENTOWN, PA.—M. S. Young & Co. are said to be contemplating the erection of a large fireproof building for their hardware business.

APPLETON, WIS.—It is stated that all bids received for the Carnegie Library, to be erected here, have been rejected, being in excess of the $50,000 appropriation. According to reports, new bids will be received for a pressed brick building.

AVONDALE, O.—E. H. Dornette, Pickering Bldg., Cincinnati, and E. N. Hannaford are stated to have completed plans for a brick school, 250x195 feet, to be erected at Reading Road and Rockdale Ave., at a cost of $160,000.

BALTIMORE, MD.—The contract for the erection of the large warehouse for the Terminal Warehouse Company has been awarded to Charles L. Stockhausen. Structure will be two stories high, 105x313 feet, situated at the corner of Front and Constitution Sts. It will have steel and corrugated iron sides and will be provided with six electric elevators. Estimated cost, $100,000.

It is stated that bids will be received until Sept. 13 by the Board of Awards (C. Clay Timanus, president) for the foundation work for the Produce Market, which is to be erected on the lot bounded by Centre Market Space, Lombard and Water Sts. and W. Falls Ave.; also separate bids for the superstructure of said building. Bids will also be received at the same time for erecting the superstructure of the Fish Market, which is to be erected on the east side of Centre Market Space, south of Baltimore St.

BINGHAMTON, N. Y.—The contracts for erecting an addition to the Binghamton State Hospital were awarded by the State Lunacy Commission to the following: Matthias Stipp, of Scranton, Pa., work of construction, $145,072; R. T. Ford, of Rochester, for heating, $13,665; R. T. Ford, plumbing, $17,900; electric light wiring and fixtures, G. & E. Electrical Construction Company, of Binghamton, $4,550.

BOSTON, MASS.—Geo. A. Smith, Harcourt St., is figuring for the erection of a $150,000 brick and stone factory, six stories, 164x48 feet, to be erected on Harcourt St. Chas. Perkins, 8 Beacon St., Boston, architect.

BUFFALO, N. Y.—Plans have been filed for an addition to the Providence Retreat at Main St. and Humboldt Parkway. The extension to be 4 and 5-story brick and terra-cotta structure, to cost $180,018. Esenwein & Johnson, architects, Ellicott Sq.

BUTTE, MONT.—Plans have been prepared by W. H. O'Brien for a residence to be erected for D. J. Hennessy. Cost, $40,000.

CHICAGO, ILL.—It is stated that W. H. Barry, 164 Dearborn St., will erect this fall 20 flat buildings in various parts of the city. E. J. Ohrenstein, architect, 164 Dearborn St. Cost, $400,000.

It is reported that an apartment house will be erected at Lake Ave. and 50th St. for C. W. Hoff, at a cost of $100,000.

The Geo. A. Fuller Company has been awarded contract for the 16-story addition to the Marquette Bldg., to cost $250,000, for which Messrs. Hollabird & Roche are the architects.

Tentative plans, subject to the approval of Marshall Field, Robert T. Lincoln and Frank O. Lowden, have been prepared for an 18-story building, costing between $2,500,000 and $3,000,000 on the site now occupied by the Pullman Bldg., at the southwest corner of Adams St. and Michigan Ave. Whether the work of tearing down the present building will begin this fall or next spring depends on the decision of the three men named. The new building is to be of steel, of modern practical design. It will be constructed primarily for the needs of the general offices of the Pullman Company.

It is stated that Jenney, Mundie & Jensen, architects, 171 La Salle St., have completed plans and are ready for bids for alterations and additions to hotel at Michigan Ave. and 12th St., for Dr. L. B. Baldwin. Building is to be converted into a hospital. Cost, $150,000.

Plans for remodeling the 4-story building at 112-118 Fifth Ave. into a 90-room hotel, are reported being prepared by Huehl & Schmid, 163 Randolph St.; improvement will cost $65,000.

It is stated that the 10-story Plymouth Bldg. at 303-305 Dearborn St., purchased by Robt. P. Lamont, of the Simplex Railway Appliance Company, is to be enlarged six stories. The improvement will cost $150,000.

Plans have been drawn by T. W. Wing, architect, 185 Dearborn St., for an apartment building, to be erected at 56th St. and Madison Ave., for A. R. Boydell. Brick and stone, three stories, 144x50 feet. Cost, $100,000.

Bids are being received by Watson & Hazelton, architects, 303 Dearborn St., for a residence for Mrs. H. J. Bardwell, to cost $60,000.

Plans have been prepared by H. L. Newhouse, architect, for an apartment house to be built at 47th St. and Lake Ave., for N. P. Cummings. Bids will be received by architect until Sept. 1. Cost, $200,000.

Frost & Granger, 184 La Salle St., are reported to have awarded the contract for erecting the 5-story Hyde Park branch Y. M. C. A. building at 53d St. and Madison Ave., at a cost of $125,000.

CHICKASHA, I. T.—Reports state that the Chicago, Rock Island & Pacific Railroad has appropriated $200,000 for the erection of four depots. W. G. Bierd, assistant to

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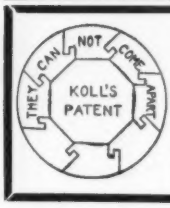

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Cincinnati, O.—Architect Frank M. Andrews, Conover Bldg., Dayton, has awarded to Henry Harig, 829 Livingston St., the contract for constructing a 9-story brick and steel fireproof hotel on Fourth St. for the Cincinnati Realty Company, to cost $1,000,000.

Cleveland, O.—John Schmeller, Park Bldg., is stated to have received the contract for erecting the Jewish Synagogue at Willson and Scoville Ave. Estimated cost, $50,000.

It is announced that $300,000 has been appropriated for a new Wabash-Wheeling & Lake Erie passenger station.

Detroit, Mich.—It is reported that Siegel, Cooper & Co., of Chicago and New York, will build a large department store southwest corner of Grand River Ave. and Rowland St.

A. C. Varney & Co. have prepared plans for a $20,000 apartment building for Chas. Coulter, to be erected on the southeast corner of Riopelle St. and Jefferson Ave.

Field, Hinchman & Smith have prepared plans for a 5-story apartment building, to be built by the Homestead Building Company, corner Charlotte and Woodward Aves. E. L. Thompson, secretary-treasurer.

N. Wardrop has prepared plans for a new building to be erected at 831-833 Superior St. for the Michigan Smelting and Refining Company, Limited.

Durham, N. C.—Sealed bids will be received until Aug. 31, 1905, for erection of a high-school building in Durham, N. C. Plans and specifications can be seen at the office of the Superintendent of City Schools at Durham, or in the office of Wheeler, Runge & Dickey, architects, Charlotte, N. C.

Fairmont, W. Va.—We are informed that Baldwin & Pennington, 311 North Charles St., Baltimore, Md., are preparing plans for a Masonic Temple to be erected here. Cost, $75,000.

Fort Worth, Tex.—It is reported that Ben J. Tiller will build a hotel, four stories high, 95x120 feet, to cost $100,000.

Frankfort, Ky.—We are informed that the State Commission has awarded contract at $880,000 to the General Supply & Construction Co., of New York City, for the construction of proposed capitol. Structure will be of Bedford (Ind.) stone with granite base.

Guelph, Ont.—Booth & Hagarty, of Brockville, are stated to have received the contract for erecting an armory at Guelph, for about $125,000.

Hague (The), Netherlands.—Architects of all countries are invited by the Committee of Trust, which has $566,000 at its disposal, to submit plans and estimates for building the Carnegie Palace of Peace at The Hague. Prizes are offered, ranging downward from $12,000, the capital prize. The committee will receive plans as late as March 15, 1906. All information desired upon which to base plans and estimates will be furnished by the Netherlands Government architect, Mr. Knuttel, who may be addressed at 16 Fluweele Burgwal, The Hague. The jury which will award the prizes is composed of architects, one each from America, Holland, England, France and Germany.

Harrisburg, Pa.—J. McKelvey, 1316 Bartine St., is stated to have received the contract for erecting a residence for P. Russ, at a cost of $20,000.

Hartford, Conn.—The Hartford Rubber Works is erecting another factory. The new building will cost $50,000. It will be 150x43 feet, three stories, with basement and sub-basement. Work has already been started in laying the concrete and foundations.

Plans are said to be nearing completion for new office building for the Travelers' Insurance Company. Brick and stone, fireproof, eight stories, 144x200 feet. Donn Barber, architect, 24 East 23d St., New York.

Hinton, W. Va.—R. F. Dunlap and associates have formed the Masonic Development Company, with capital stock of $100,000, to build theatre, Masonic Temple and business building combined; five stories, 70x100 feet, brick and stone. Cost, $50,000. Frank P. Milburn, Columbia, S. C., architect.

Huntington, L. I., N. Y.—Wilson Eyre, 35 West 21st St., New York, is taking figures on a 2-story residence, 175x50, to be erected for Roland R. Conklin, 111 Broadway. Estimated cost, $120,000.

Hackensack, N. J.—At a special meeting of the Hackensack board of education William H. Whyte was awarded the contract to build the extensions to the High and State St. schools. His bid was $41,500.

Indianapolis, Ind.—It is stated that John Lazarus, chairman Building Committee, has asked architects to submit plans for proposed Board of Trade Bldg.

It is announced that the trustees of the Henon Art Institute will soon receive bids for construction of a new $80,000 art building. The building will be of pressed brick and oolitic stone.

John Pierce is reported to have been awarded contract for erection of new Knights of Pythias Bldg. in this city for $400,000.

The Indianapolis Building and Investment Company is reported incorporated with a capital of $200,000, to erect a hotel at 136 to 144 S. Illinois St. by W. A. O'Brien.

The Labb & Given Amusement Company, of Broad Ripple, Ind., is reported to be planning to build somewhere in or near Indianapolis an amusement place similar to the "White City" of Chicago. Site will be chosen soon and plans for buildings are now about completed. Cost, $150,000.

Contract for construction of new cathedral at 14th and Meridian Sts. has been let to Albert Von Spreckelson for $109,445.

Jefferson City, Mo.—The Hill-O'Meara Construction Company has been awarded contract at $176,000 for the erection of the Missouri Supreme Court Bldg. Marner & Le Beaume, architects.

Jersey City, N. J.—We are informed that St. Paul's German Evangelical Church has decided to purchase property on Hoboken Ave., now owned by William Meade, and the Buskirk estate, and to erect a church, costing at least $40,000.

Kansas City, Mo.—It is reported that the Sheidley Estate will build a warehouse 145x140 feet after plans and specifications now on file. Cost, about $50,000.

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TIMES BUILDING

NEW YORK

C. P. Batchelor will erect a brick apartment house at Ninth St. and Troost Ave., to cost about $85,000.

LATONIA, KY.—Kyle & McDermutt, of Covington, have contract to erect the brick and stone county infirmary at $106,000. G. W. Jameson, chairman committee, Covington.

LONG BEACH, CAL.—C. R. Drake, president Seaside Water Company, and others are reported to have in contemplation the erection of a hotel to cost $250,000.

LOS ANGELES, CAL.—E. J. Le Breton, of San Francisco, has given $225,000 to build a home in this city for the Aged and Indigent poor that are now under the care of the Roman Catholic Society, known as Little Sisters of the Poor. Plans for the new building have been drawn by John Parkinson, 606 Laughlin Bldg.

A corporation has been formed in Los Angeles for the purpose of constructing a tourist hotel at the corner of Magnolia Ave. and Seaside boulevard. The Seaside company, the Pacific Electric and the Salt Lake are back of the project. Company is capitalized at $500,000.

LOUISVILLE, KY.—Plans have been prepared by Mason Maury, Board of Trade Bldg., for apartment house to be erected by a syndicate formed by Walter S. Adams, Real Estate Broker. Cost, $350,000.

It is reported that the Western Jockey Club will build a grandstand, costing $60,000.

LYONS, IA.—Bids will be received until Sept. 2 by the Board of Education, Independent School District, for erecting a High School, after plans by Semple, Burrows & McLane, architects, 63 McManus Bldg., Davenport. J. W. McPherson, Sec'y.

MONTREAL, CAN.—The Walter M. Lowney Chocolate Co., Boston, Mass., will erect a factory in Montreal, 100 by 100 feet, six stories high, at the cost of about $63,000.

MARION, O.—Plans are reported to have been completed by Wilson Eyre, 35 West 21st St., New York, for a residence to be erected here for G. W. King. Brick and marble, 3 stories, 45x115 ft. Cost, $100,000.

MEMPHIS, TENN.—Myer J. Strum, 84 La Salle St., Chicago, Ill., has revised plans and is taking figures on a hospital, to be erected at Memphis for The Women's Hospital. Brick, 4 stories, 45x100 ft. Cost, $50,000.

A. B. Groves, St. Louis, Mo., has prepared plans for an 8-story bank and office building, to be erected at Second and Jefferson Sts. R. E. McGill, Southern Express Co. Bldg., Memphis, is said to be interested. Cost, $250,000.

It is reported that the Business Men's Club will erect 6-story building with basement and roof garden. Architect not yet engaged. R. F. White, Sec'y.

It is stated that the L. M. Weathers Co. has begun preparation of plans and specifications for the nave of St. Mary's Cathedral Bldg., which will cost from $30,000 to $40,000.

It is stated that Harry P. Johnson will build a $25,000 residence of press brick and stone. Architect not yet selected.

John R. Pepper has permit for erection of residence, to cost $25,000.

The Royal Realty Co. has leased the Planters' Bldg. and will add two stories, beside making other improvements, at a cost of about $75,000.

MILLERSVILLE, PA.—The School Board has plans ready for bids for a new normal school, to cost $75,000.

MOBILE, ALA.—The Southern Ry. Co., it is stated, has awarded the contract to erect the union passenger station in this city to the General Supply & Construction Co., of New York City, at about $500,000.

MONTEREY, CAL.—Bids will be received until Sept. 11 by Col. Wm. S. Patten, Assistant Quarter Master General, U. S. A., San Francisco, for construction and electric wiring of frame additions to 16 sets barrack buildings at the Presido of Monterey.

MONTCLAIR, N. J.—Grosvenor Atterbury, 20 West 43d St., New York, has just awarded to N. P. Nelson, 127 Valley Road, Montclair, the general contract to build a 2½-story residence, 40x90, for Edwin A. Bradley, 20 Van Vleck St., Montclair, to be erected on Mountain Ave., that city, at an estimated cost of $75,000.

MONKS CORNER, S. C.—Sealed bids for erection of jail will be received until September 4. Plans and specifications on file at office of the County Commissioners.

MUNCIE, IND.—The plans of Alfred Grindle are stated to have been accepted for the terminal station, to be erected by the Indiana Union Traction Co., Wm. C. Sampson, Sec'y., at a cost of $45,000.

NEEDHAM, MASS.—It is reported that the J. W. Bishop Co., Boston, has been awarded the contract to erect a $500,000 residence for H. D. Scott in Needham.

NORTH YAKIMA, WASH.—Plans submitted by N. C. Gauntt, for the construction of new court-house have been accepted by the commissioners. Total cost, $75,000.

NEW BEDFORD, MASS.—The Board of Aldermen of New Bedford, voted recently to discontinue Purchase Ave. from Purchase St. to the tracks of the Fall River branch railroad in order that the Beacon Mfg. Co. may extend its plant. The company on its part agrees to build within a reasonable time an addition valued at not less than $200,000 or forfeit $5,000 to the city. It is understood that the mill managers are prepared to proceed at once to build the addition.

NEW CASTLE, PA.—It is said that a $35,000 dormitory will be erected at the Western Pennsylvania Colored Industrial School in this city, according to plans of the President, Rev. Geo. W. Kincaid.

ARCHITECTURAL ORNAMENTS

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NEW ORLEANS, LA.—The Improved Order of Elks has authorized an expenditure of $50,000 to enlarge and improve its present home building.

The Harmony Club, it is reported, will expend $75,000 to enlarge its home building.

NEW YORK, N. Y.—(Borough of Manhattan).—A press report states that the City Real Property Investing Co. has sold the 12 4-story business buildings at the corner of Broad and Beaver Sts. to a syndicate composed of the Century Realty Co., the City Investing Co. and the United States Realty & Construction Co. The property has a frontage of 99.8 feet on Broad St., and 229.6 feet on Beaver St. It includes the building at No. 8 South William St. The entire parcel contains 22,406 square feet. The syndicate is understood to have received offers for parts of the site from several banking houses.

Joseph Wolf, West 34th St., has completed plans and awarded contracts for the erection of the 8-story loft and warehouse, 75x100, which the Fischer Realty Co., 395 Greenwich St., will build at 371-75 Greenwich St., at a cost of $125,000.

The following bids have been opened by C. B. J. Snyder, Superintendent School Bldgs., New York City, for general construction, etc., of School 90, Manhattan Borough; Buckley Realty Construction Co., $473,000; Thos. Cockerill & Son, $468,900; Thos. B. Leahy Building Co., $509,321; P. J. Brennan, $455,000; Chas. H. Peckworth, $482,521; Richard E. Henningham, $454,950; Geo. Hildebrand, $462,000; Attilio Pasquini, $548,640, and Walters & O'Connell, 100 Duane St., New York City, $453,594 (awarded contract).

Moore & Landsiedel, Third Ave. and 148th St., are drawing plans for a 6-story apartment, 100x102, for the Transit Realty Co., 198 Broadway, to be erected at the northeast corner of 137th St. and Riverside Drive. Cost, $150,000.

Sobel & Kean Co., 68 Edgecombe Ave., will build four 6-story flats on the south side of 109th St., near Central Park West, costing $160,000. J. C. Watson, 3 St. John's Ave., architect.

Plans are ready for bidders for the erection of the 8-story loft building, 46.6x125, to be erected for Lord & Taylor, on the northeast corner of Fifth Ave. and 19th St., at a cost of $300,000. Three old buildings will be demolished. No contracts have been awarded. John H. Duncan, 208 Fifth Ave., architect.

Maximilian Zipkes, 147 Fourth Ave., is preparing plans for two houses to be erected on a plot, 114.10x100, on west side of Thompson St., 100 ft. north of Broome St. Cost, $125,000. Messrs. Kohn & Craft, owners.

V. J. Hedden & Sons Co., 1 Madison Ave., is taking figures for addition to Metropolitan Life Insurance Bldg., to be erected at Fourth Ave. and 24th St. H. Le Brun & Sons, 1 Madison Ave., architects; A. R. Wolff, 130 Fulton St., steam engineer, and C. O. Mailloux, 76 William St., electrical engineer.

William Henderson, 1123 Broadway, has the general contract to build 5½-story residence, 20x62, which Dr. Richard H. Derby, 9 West 35th St., will erect at 113 East 71st St., at an estimated cost of $40,000. Hoppin, Keon & Huntington, 244 Fifth Ave., architects.

Geo. Fred Pelham, 503 Fifth Ave., is making plans for two 6-story flats, 50x56, for Kessler & Bookstaver, 49 West 112th St., to cost $101,000. They will be erected on the northwest corner of 137th St. and Fifth Ave.

Plans are under way in the office of Horenburger & Straub, 122 Bowery, for four 6-story flats, to be situated on the south side of 18th St., 95.6 ft. west of Ave. B, to cost $160,000. Paul Hellman, 160 East 66th St., Thomas Crump, 66½ Water St., and Hugo Cohen, 19 Ave. A, owners.

Plans have been completed by Raymond F. Almirall, 51 Chambers St., for the 6-story fireproof municipal house for men, to be situated on the south side of 25th St., 400 ft. east of First Ave., at a cost of $150,000. The city of New York is the owner.

It is stated that Josephine D. Robinson has purchased a plot, 25x92, numbered 18 West 21st St., on which she will build a 10-story fireproof store and loft building.

Benj. W. Levitan, 20 West 31st St., is making plans for three 6-story flats, 40x87.5, for Lewine & Davis, 1 East 107th St., to be erected on 67th St., near Second Ave., to cost $120,000. The same architect and David Herman, owner, 53 East 112th St., are taking figures on a 6-story apartment house, 100x100, to be erected at the southeast corner of Lenox Ave. and 136th St., at an estimated cost of $130,000.

It is said that Glasser & Ebert, 70 Manhattan St., are drawing plans for two 5-

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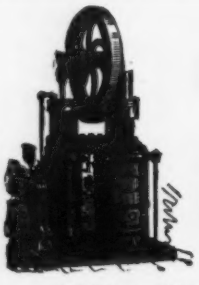

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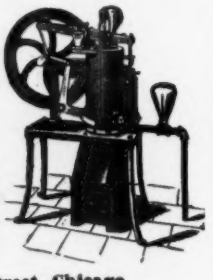

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story flats, for the Cascade Realty and Construction Co., 272 West 113th St., to be erected on the west side of Amsterdam Ave., 25 ft. south of 178th St. Cost, $90,000.

It is reported that as yet architect has not been selected for the Temple Israel to be erected on a plot, 100x100, at the northwest corner of Lenox Ave. and 120th St. Four well-known architects are said to have been asked to present studies, and it is hoped that award will be made and work started in about a month. The site of the old Temple at Fifth Ave. and 125th St. was sold to Herman Wronkow, 23 Union Sq., who will, as soon as possession can be obtained and the old church building cleared, build a store and apartment building. At his office it was stated that no plans or architect has been selected.

Plans are nearing completion for the new terminal for the New York Central & Hudson River R. R. Co., to be erected at 42d to 45th Sts., between Madison and Lexington Aves. Warren & Wetmore, 3 East 33d St., associated with Reed & Stein, 7 East 42d St., are the architects. Figures will be taken about Sept. 1st. Cost, $17,000,000.

(Borough of Brooklyn.)—Plans are reported to have been completed by L. H. Giebe, 147 Hutton St., Jersey City, for the R. C. Orphan Asylum Society, 4 Court St., Brooklyn, for a 1-story church, 63x140, to be erected corner of Albany and St. Mark's Aves. Cost, $90,000.

(Borough of Bronx.)—Maximilian Zipkes, 147 Fourth Ave., is preparing plans for six 5-story and basement flats, to be erected on the northwest corner of 138th St. and Cypress Ave., for Harry Goodstein, on a plot 225 ft. on 138th St. and 100 ft. on Cypress Ave. Cost, $200,000. Same architect is preparing plans for three 5-story stores and tenements, to be erected on the northwest corner of Washington and Vendover Aves., for Louis E. Kleban, on a plot, 125x100, at a cost of $175,000.

Norwalk, Conn.—The plans for the proposed Norwalk High School building show a brick structure with stone trimmings and galvanized iron cornices. It is estimated the cost, with furnishings, will be $125,000.

Norfolk, Va.—The Jefferson Realty Corporation has had plans and specifications revised by J. Kevan Peebles, architect, for the construction of its proposed hotel. The structure is to be seven stories high, have all modern improvements, and cost $400,000.

Orange, N. J.—It is reported that bids will be received until Aug. 30 by the Board of Education for erecting the Central School at Main and Cleveland Sts. Probable cost, $125,000. Herbert D. Hale, architect, 92 William St., New York.

Ossining, N. Y.—Renwick, Aspinwall & Tucker, 320 Fifth Ave., New York, are reported to be taking figures on the general contract for a 3-story fireproof hospital building, 60x120, to be erected here, for the Ossining Hospital Association, at an estimated cost of $75,000.

Pensacola, Fla.—It is reported that an election will be held soon to decide on erecting a $75,000 police court and jail.

Philadelphia, Pa.—J. E. & A. L. Pennock, Land Title Bldg., are stated to have received the contract for erecting a 3-story brick and stone residence on Queen Lane, near Wissahickon Ave., for Clarence M. Clark. Horace W. Sellers, architect. Cost, $100,000.

It is stated that Field & Medary, 1414 S. Penn Sq., will soon receive bids for a branch Carnegie Library to be erected at 17th and Spring Garden Sts. It is to be a 1-story brick structure with terra-cotta trimmings.

Wm. J. Gruhler, of Germantown, is reported to have received the contract for the erection of a $20,000 addition to the residence of Randal Morgan, of Chestnut Hill. The building will be three stories high, 24x44 feet.

It is reported that Cramp & Co., 1421 Filbert St., have received the contract to erect a store building on 15th and Chestnut Sts., at a cost of $60,000.

W. L. Blithe, 14 S. Broad St., is reported to be receiving bids for a church and Sunday school at 54th and Catharine Sts. for the Wharton St. M. E. Church. Cost, $100,000.

It is stated that Horace Trumbauer, Land Title Bldg., has started final plans for new clubhouse for the Racquet Club at 16th and Walnut Sts. It will be of brick, stone and steel, fireproof, five stories, 140x180 feet. Cost, $200,000.

The Chas. McCaul Company, 10 N. 11th St., has been granted permit to erect a 2-story exchange, 65x96 feet, at Lancaster Ave. and Media St., for the Bell Telephone Company. Cost, about $80,000.

It is stated that bids will be received about Sept. 1 for erecting a 142x143-foot building at Broad and Chestnut Sts. for the Girard Trust Company, at a cost of $1,500,000. Allen Evans, of Philadelphia, and McKim, Mead & White, 160 Fifth Ave., New York, N. Y., architects.

Pittsburgh, Pa.—Property at 106-110 Wood St. has been purchased by Isaac Kaufmann, who is having plans drawn for a warehouse to be erected on this site, costing not less than $100,000.

Red Oak Park, N. J.—A press report states that Paul J. Corn, New York City, has purchased 1,375 acres of land in Ocean and Burlington counties, on which extensive brick and pottery works will be erected.

Rutherford, N. J.—It is stated that the Board of Education will advertise for bids in about a week for construction of a new school building to cost $48,000.

San Francisco, Cal.—Plans are in the hands of Bliss & Faville, Crocker Bldg., for the Clara Barton Hospital, which is to be erected in this city and is to be a 7-story and basement structure, costing $250,000.

Thos. Butler has received the contract for erecting the U. S. Custom House at San Francisco, at $1,119,300.

Salem, Ore.—Bids will be received until Sept. 5 by the Commissioner of Indian Affairs, Department of the Interior, Washington, D. C., for furnishing material and constructing two frame barns, with plumbing and electric light, a frame employés' quarters and a brick hospital, both with plumbing, steam heat and electric light, at the Salem School, Ore. For further information apply to Edwin L. Chalcraft, Chemawa, Ore.

Schenectady, N. Y.—A new Y. M. C. A. building will be erected here. Plans not yet perfected and site not chosen. Mason W. Hall, president.

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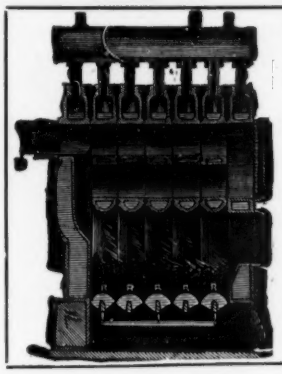

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ST. PAUL, MINN.—Plans are stated to have been completed for a concrete pavilion to be erected at Como Park, at a cost of $40,000.

The plans of A. F. Gauger are said to have been approved by the Board of Trustees for the 3-story building for the Soldiers' Home. Probable cost of structure, $75,000.

SEATTLE, WASH.—A 12-story reinforced concrete building, 60x108 feet, will be erected by Thos. Burke, 912 Second Ave. Cost, $250,000.

It is reported that the plans of Kerr & Rogers, Hancock Bldg, have been approved for the armory to be erected here. Probable cost, $100,000.

SHELBYVILLE, KY.—Shelby County Fiscal Court will call an election in November to vote upon the issuance of $75,000 in bonds for the erection of the proposed courthouse.

SIOUX CITY, IA.—The Congregation of the First Baptist Church is reported to have in contemplation the erection of an edifice to cost $45,000.

SHAWNEE, OKLA.—Sealed proposals addressed to the Commissioner of Indian Affairs, Washington, D. C., will be received at the Indian office until Sept. 14, 1905, for furnishing and delivering materials and labor required to construct and complete two brick dormitories and one mess hall and water and sewer system at the Shawnee school, Oklahoma, in accordance with plans, specifications and instructions to bidders. For further information apply to F. A. Thackery, superintendent, Shawnee, Okla.

SLIPPERY ROCK, PA.—Excavating has commenced on a 2-story brick and stone gymnasium and music hall to be constructed for the Slippery Rock Normal School from plans drawn by Architects S. W. Foulk & Son, of New Castle. Cost, $50,000.

STATE COLLEGE, PA.—George F. Payne & Co., 401 S. Juniper St., Philadelphia, have received the contract for constructing a 3-story brick agricultural building on the college campus for the trustees of State College. Plans by Architect Edward Hazelhurst, Girard Bldg., Philadelphia. Cost, $75,000.

SYRACUSE, N. Y.—It is stated that the local alumni association of the Phi Delta Theta fraternity has decided to go ahead at once with the construction of the proposed $42,000 chapter house on property owned by the association in College Pl., between the residences of Prof. William H. Mace and Librarian E. W. Mundy. Plans by George L. Heins, the State architect.

TALLAHASSEE, FLA.—We are informed that Edwards & Walter, architects, Columbia, S. C., are preparing plans for a school building to be erected in Tallahassee, to contain 12 rooms and auditorium. Bids will be received until Sept. 10.

TIFFIN, O.—Architects Patton & Miller, 927 E. High St., Chicago, Ill., have been selected to prepare plans for a dormitory to be constructed on Perry and Greenfield Sts. for Heidelberg University. Cost, $25,000.

TRENTON, N. J.—The Mercer Building Company, City Hall, will erect a 10-story fireproof steel-frame office building in Trenton, for which no architect or plans have yet been selected and no contracts awarded for its erection.

WASHINGTON, D. C.—The contract for erection of the Industrial Home School for the District of Columbia has been awarded to Isidore Pavarini, 814 18th St. N. W. Cost, $110,000.

It is stated that A. O. Von Herbulis, architect, Kellogg Bldg., is ready for bids for a gymnasium building for the University of Georgetown. Stone and steel, fireproof, 1-story, 75x200 feet. Cost, $135,000.

Contract for erecting an addition to the marine barracks, including bandroom, mess hall, gymnasium, guardroom, prison and amusement-room is stated to have been awarded to Chas. McCaul Company, of Philadelphia, Pa., for $91,126.

John Miller, president of John Miller Coal Company, will erect five residences after plans and specifications by B. Stanley Simmons at a total cost of $50,000.

B. T. Warder has received permit for the erection of a 5-story dwelling after plans and specifications by Bruce, Price & De Sibour, architects, of New York City. Contract has been awarded to Richardson & Burgess at about $150,000.

WELLSTON, O.—Sealed proposals will be received at the office of the clerk of the Board of Education of Wellston City School District, Jackson County, Ohio, until Sept. 11, 1905, for furnishing all materials and doing all work necessary for the construction of an 8-room school-house on lots 537 and 548, in Pavey's Addition to Wellston, O., in said district, in accordance with the plans and specifications on file at the office of the clerk and at the office of Wilbur T. Mills, architect, 231 N. High St., Columbus, O.

WINONA, MINN.—It is stated that a Y. M. C. A. building will be erected here, at a probable cost of $40,000.

WHIPPLE BARRACKS, ARIZ.—Bids will be received until Sept. 8 for the construction, plumbing, hot-water heating and electric wiring of hospital. Capt. Chas. C. Walcutt, Q.M., Prescott, Ariz.

ZANESVILLE, O.—Badgley & Nicklas, 1273 Euclid Ave., Cleveland, are reported to be preparing plans for a 2-story, 135x140-foot brick edifice, to be erected here for the congregation of the Second M. E. Church, at a cost of $60,000.

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Neuchatel Asphalt Co., New York.
Warren Chemical & Mfg. Co., New York

ASPHALT ROOFING.
American Asphaltum & Rubber Co., Chicago.
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Moss, Chas. E., Boston.
Spaulding Print Paper Co., Boston.

BRASS GOODS (Plumbers).
Standard Sanitary Mfg. Co., Pittsburgh, Pa.

BRONZEWORK (Ornamental).
Jackson, Wm. H., Co., New York.
Richey, Browne & Donald, Maspeth, L. I., New York City.
United States Foundry and Sales Company, South Norwalk, Conn.
John Williams, New York.
Winslow Bros. Co., The, Chicago, Ill.

CAPITALS AND COLUMNS.
Hartmann Bros. Mfg. Co., Mount Vernon, N. Y.

CEMENT.
Alsen's Cement Works, New York.
Atlas Cement Co., New York.
Illinois Steel Co., Chicago.

CEMENT (Non-Staining).
Morse, Frank E., Co., New York.

CLOSETS.
Standard Sanitary Mfg. Co., Pittsburgh, Pa.

COLUMNS (Lock Joint).
Hartmann Bros. Mfg. Co., Mount Vernon, N. Y.

CONCRETE CONSTRUCTION.
R. S. Blome Co., Chicago.

CONSERVATORIES.
Lord & Burnham Co., Irvington-on-Hudson, N. Y.

CONTRACTORS AND BUILDERS.
Morrill & Whiton Construction Co., Boston.

CORDAGE.
Samson Cordage Works, Boston.

DOORS (Steel Rolling).
Kinnear Mfg. Co., The, Columbus, O.

DRINKING FOUNTAINS.
Standard Sanitary Mfg. Co., Pittsburgh, Pa.

ELECTRIC SIGNALS.
Elevator Supply & Repair Co., New York

ELEVATORS, ETC.
Otis Elevator Co., New York.

ENAMELLED IRON (Plumbers' Ware.)
Standard Sanitary Mfg. Co., Pittsburgh, Pa.

ENGINES (Hot-Air).
Rider-Ericsson Engine Co., New York

FAN SYSTEM.
Sturtevant Co., B. F., Boston.

FILTERS.
Loomis-Manning Filter Co., Phila., Pa
Cummings Filter Co., Pittsburg, Pa.

FIRE-ESCAPES.
Standard Fire-escape & Mfg. Co., Boston

FIREPROOFING.
Associated Expanded Metal Co., New York.
Blome, R. S., Co., Chicago.
Imperial Expanded Metal Co., Chicago.
National Fireproofing Co., Pittsburg, Pa.
Trussed Concrete Steel Co., Detroit

FIREPROOF LATHING.
Hayes, Geo., New York.

FIREPROOF SHUTTERS.
Kinnear Mfg. Co., The, Columbus, O.

FLOOR POLISH.
Butcher Polish Co., Boston.

FUEL ECONOMIZERS.
Sturtevant & Co., B. F., Boston, Mass.

GLASS (Figured and Ornamental).
Mississippi Wire Glass Co., New York

GRATES, MANTELS, ETC.
Wm. H. Jackson Co., New York.

GREENHOUSES.
Lord & Burnham Co., Irvington, N. Y.

HARDWARE
Sargent & Co., New York.
Yale & Towne Mfg. Co., Stamford, Ct.

HEATING APPARATUS (Hot Water).
Gurney Heater Mfg. Co., Boston.
Lord & Burnham Co., Irvington, N. Y.
H. B. Smith Co., New York.

HEATING-APPARATUS (Steam).
Lord & Burnham Co., Irvington, N. Y.
Smith Co., H. B., New York.

INSULATED WIRE.
The Okonite Co., (Ltd.), N. Y.

INTERLOCKING RUBBER TILING.
New York Belting & Packing Co., Ltd., New York.

IRONWORK (Ornamental).
Jackson, Wm. H., Co., New York.
W. H. Mullins Co., Salem, O.
Richey, Browne & Donald, Maspeth, L. I., New York City.
United States Foundry and Sales Company, South Norwalk, Conn.
Winslow Bros. Co., The, Chicago, Ill.

IRON WORKS.
Mott Iron Works, J. L., New York.

LAUNDRY MACHINERY.
Troy Laundry Machinery Co., Troy, N. Y.

LAUNDRY TUBS (Porcelain Enamelled).
Standard Sanitary Mfg. Co., Pittsburgh, Pa.

LAVATORIES (Porcelain Enamelled).
Standard Sanitary Mfg. Co., Pittsburgh, Pa.

LEAD PIPE.
Standard Sanitary Mfg. Co., Pittsburgh, Pa.

MAIL CHUTES.
Automatic Mail Delivery Co., New York
Cutler Mfg. Co., Rochester, N. Y.

MARBLE.
Standard Sanitary Mfg. Co., Pittsburgh, Pa.

MARBLE-WORKERS.
The Robert C. Fisher Co., New York.

METAL CEILING.
The Berger Mfg. Co., Canton, Ohio.
W. H. Mullins Co., Salem, O.
See also Fireproofing.

METAL FURNITURE.
Art Metal Construction Co., Jamestown, N. Y.

METAL LATHING.
G. Hayes, New York.
Truss Metal Lath Co., New York.

MINERAL WOOL.
U. S. Mineral Wool Co., New York.

MORTAR COLORS.
Saml. H. French & Co., Phila., Pa.

PAINT.
Joseph Dixon Crucible Co., Jersey City, N. J.
New Jersey Zinc Co., New York.

PHOTOGRAPHS.
J. W. Taylor, Chicago, Ill.

PHOTOGRAPHY (Architectural and Commercial).
Dadmun, Leon E., Boston.

PLASTER ORNAMENTS.
Samuel H. French & Co., Phila., Pa.

PORCELAIN ENAMELLED WARE.
Sanitary Standard Mfg. Co., Pittsburgh, Pa.

PUMPS.
Rider-Ericsson Engine Co., New York.

RADIATORS.
Shirley Radiator & Foundry Co., Indianapolis, Ind.

RANGE CLOSETS.
Standard Sanitary Mfg. Co., Pittsburgh, Pa.

REFLECTORS.
I. P. Frink, New York.

REINFORCED CONCRETE.
Trussed Concrete Steel Co., Detroit.

ROOFING MATERIALS.
Barrett Mfg. Co., New York.
Blome, R. S., Co., Chicago.
See also Asphalt Roofing.

ROOFING TIN.
American Tin Plate Co., New York.
Taylor Co., N. & G., Philadelphia, Pa.

SASH-CORD.
Samson Cordage Works, Boston.
Silver Lake Co., Boston.

SCHOOLS OF ARCHITECTURE.
Lawrence Scientific School, Harvard University, Cambridge, Mass.
Massachusetts Institute of Technology, Boston.
Ohio State University, Columbus, O.
Pratt Institute, Brooklyn, N. Y.
Society of Beaux-Arts Architects, The, New York.
University of Pennsylvania, Phila., Pa.
Washington University School of Engineering and Architecture, St. Louis, Mo.

SEAMLESS TUBING.
Benedict & Burnham Mfg. Co., Waterbury, Conn.

SHEET-METAL WORK.
W. H. Mullins Co., Salem, O.
J. S. Thorn Co., Phila., Pa.

SHOWERS (Permanent & Portable).
Standard Sanitary Mfg. Co., Pittsburgh, Pa.

SHUTTERS (Steel Rolling).
Kinnear Mfg. Co., The, Columbus, O.

SKYLIGHTS, ETC.
George Hayes, New York.
W. H. Mullins Co., Salem, O.
Valle & Young, Baltimore, Md.

SKYLIGHT GLASS.
Mississippi Wire Glass Co., New York

STABLE FIXTURES.
Broad Gauge Iron Stall & Vane Works, Boston.

STAIR TREAD.
American Mason Safety Tread Co., Boston.

STEEL ROLLING-DOORS.
Kinnear Mfg. Co., The, Columbus, O.

TERRA-COTTA.
The Northwestern Terra-Cotta Co., Chicago, Ill.

TILES.
Jackson, Wm. H., Co., New York.

TILES (Interlocking Rubber.)
N. Y. Belting and Packing Co., Ltd., New York.
Pennsylvania Rubber Co., Jeannette, Pa

TRAPS.
Cudell, F. E., Cleveland, O.

URINALS (Porcelain Enamelled).
Standard Sanitary Mfg. Co., Pittsburgh, Pa.

VALVES AND PACKING.
Crane Co., Chicago, Ill.
Jenkins Bros., New York.

VARNISH.
Edward Smith & Co., New York.

VENTILATION.
Globe Ventilator Co., Troy, N. Y.

VIMOMETERS.
Standard Sanitary Mfg. Co., Pittsburgh, Pa.

WATERPROOFING.
Barrett Mfg. Co., New York, N. Y.

WEATHER VANES.
T. W. Jones, New York.

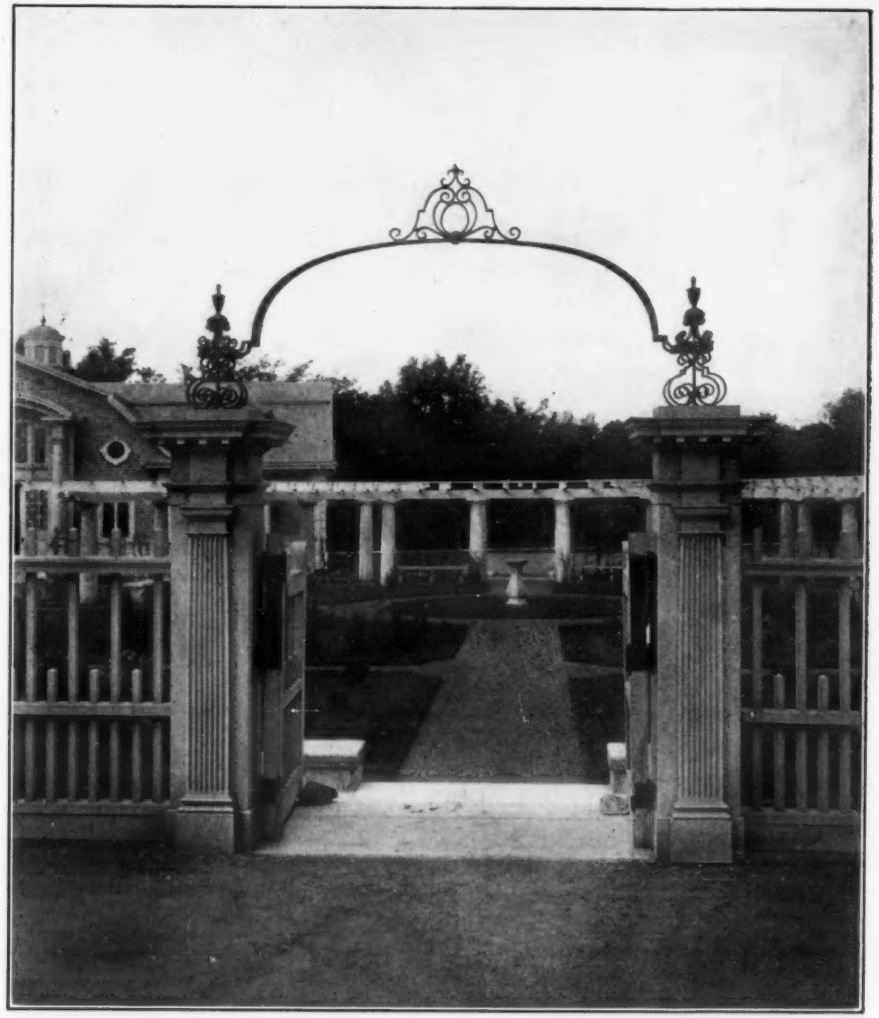
WINDOW LINE.
Samson Cordage Works, Boston.

WIRE GLASS WINDOWS.
George Hayes, New York, N. Y.
L. & R. Wister & Co., Philadelphia.
Mississippi Wire Glass Co., New York.
James A. Miller & Bro., Chicago, Ill.

ZINC WHITE.
New Jersey Zinc Co., New York.

HAUS TRARBACH, 47 BEHRENSTRASSE, BERLIN, PRUSSIA.

Richard Walter, Architect.



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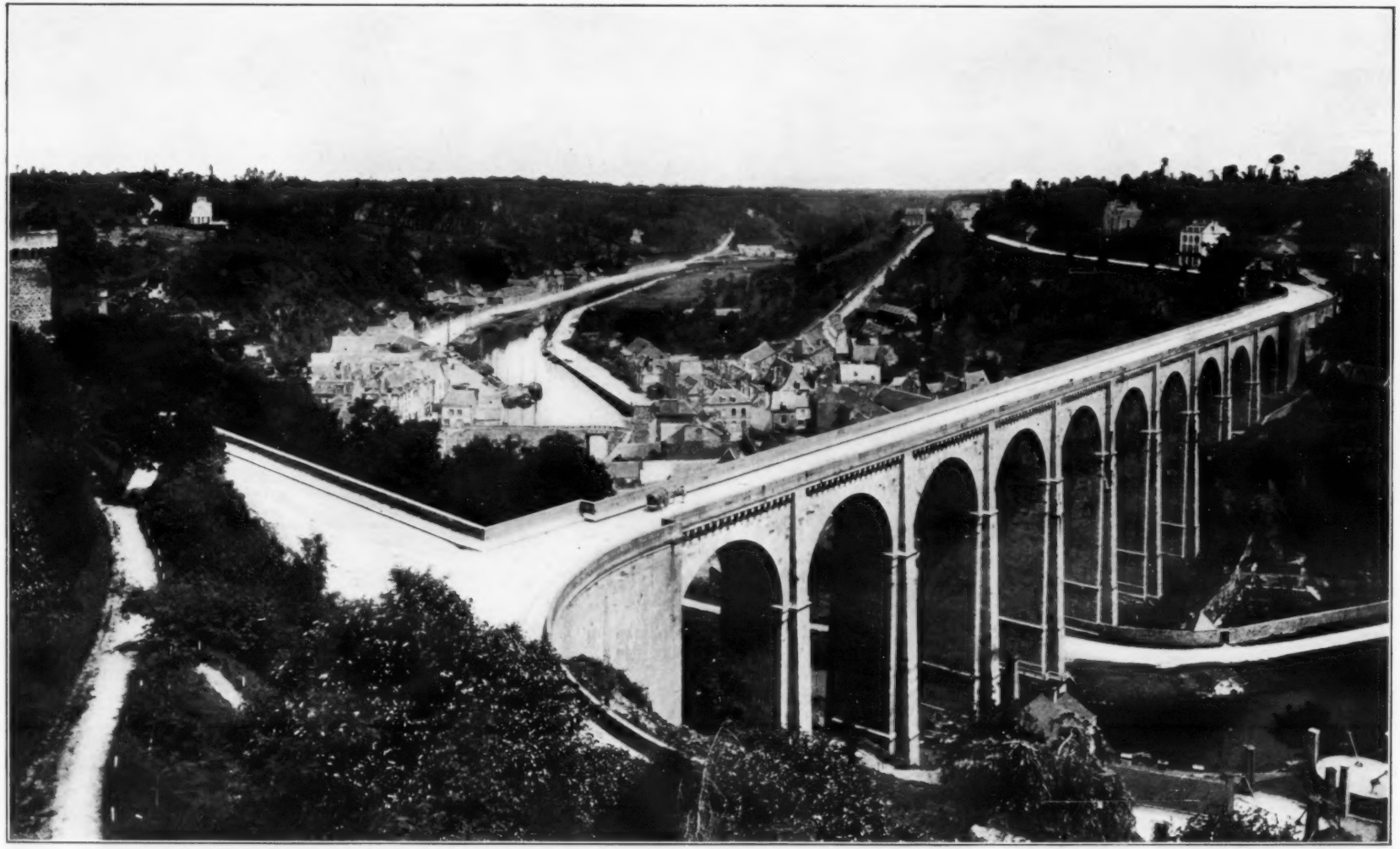

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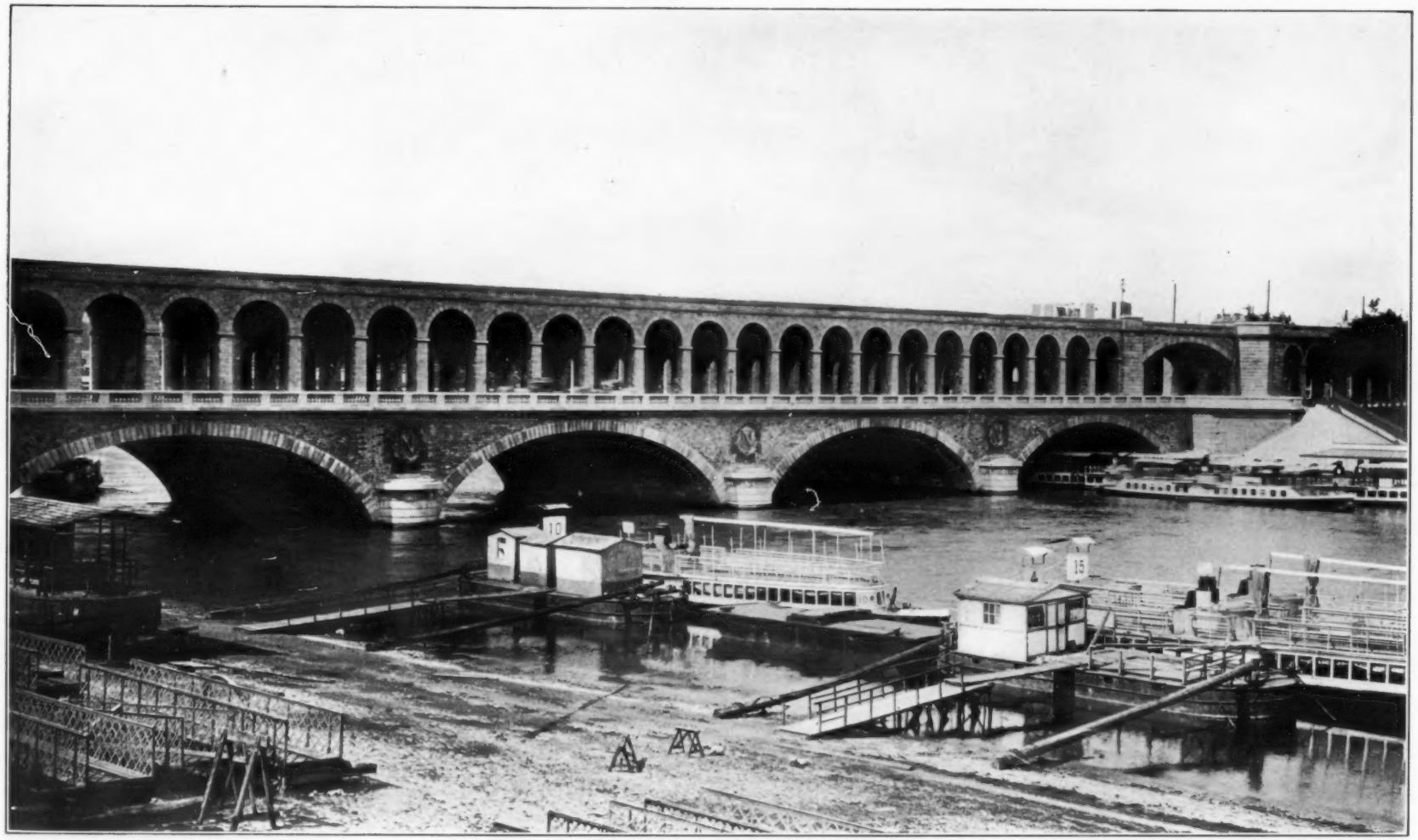

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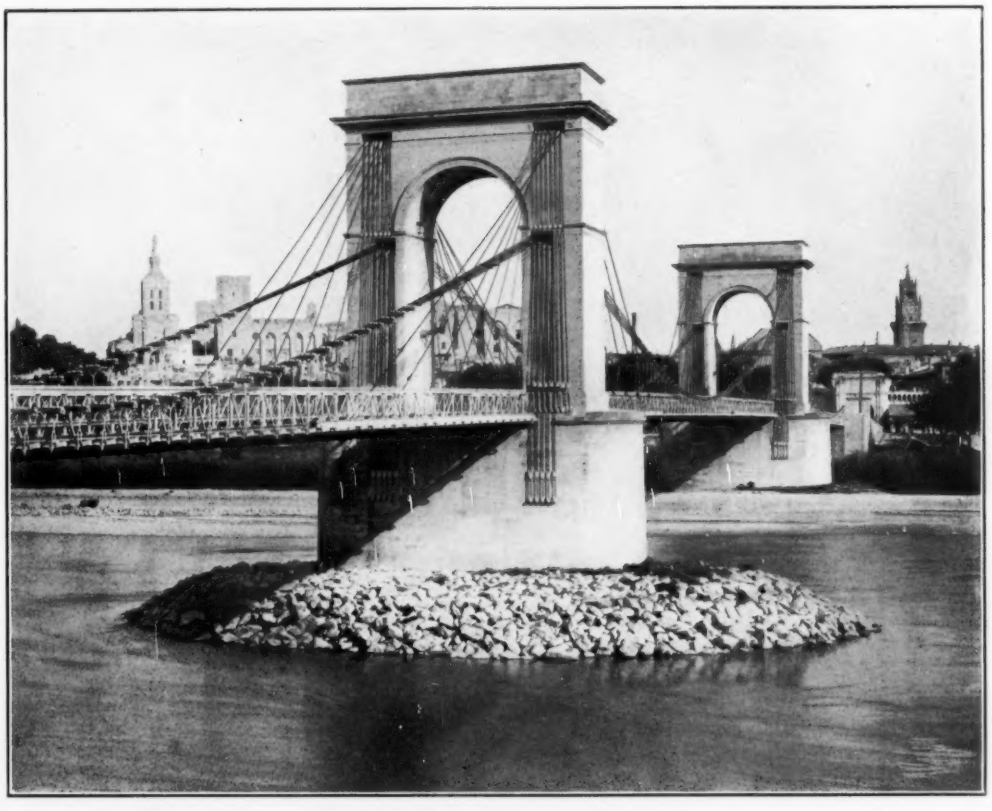

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